KNOWLEDGE
AN ILLUSTRATED
MAGAZINE OF SCIENCE
SIMPLY WORDED—EXACTLY DESCRIBED

LONDON: MAY 1, 1890.

CONTENTS.

House-flies and Bluebottles.—III. By E. A. Butler ... 123
Pouched Mammals. By R. Lydekker, B.A.Cantab ... 125
On the Great Bright Streaks which Radiate from some of the Larger Lunar Craters. By A. C. Ranyard ... 128
Venomous Spiders. By A J. Field 131
A Gully in the Blue Mountains. By C. Parkinson, F.G.S. 134
Notices of Books 135
Letters:—Frank Atkinson, Arthur Nicols, C. Parkinson, J. Shaw 137
The Face of the Sky for May. By Herbert Sadler, F.R.A.S. 139
Whist Column. By W. Montagu Gattie 140
Chess Column. By I. Gunsberg 142

HOUSE-FLIES AND BLUEBOTTLES.—III.

By E. A. Butler.

THERE yet remains the head of our bluebottle to be examined. It is a broad, almost triangular plate, united to the thorax by a junction so slender and delicate that the whole head is readily rotated round it through an angle of more than 90 degrees either way; hence often happens in the dead and dried specimen a catastrophe most unwelcome to the possessor of a collection; a jar or jerk, or an accidental touch, instantly severs the head from the body and ruins the specimen; this unenviable notoriety flies share with dragon flies. Under the microscope the head is a really handsome object, especially when viewed with reflected light. The multitude of detail, the quaintness of form of many of the parts, and the harmony of colouration throughout, combine to make it an object to which only a long and attentive examination can do justice.

The sides are almost entirely occupied with the enormous and strongly convex masses of the compound eyes (Fig. 5), of a colour varying from bright red to dark brown; this appearance is caused by the pigment beneath showing through the transparent cornea; behind, they are delicately bordered with silvery tomentum. The facets, very numerous and for the most part hexagonal in outline, cannot be made out at all without the help of a lens, and then only when a good light is playing on them. Their form is best seen by stripping off the transparent cornea and examining it with transmitted light. It depends on the sex what proportion the area of these eyes bears to the whole surface of the head. In the males, the eyes spread farther towards the centre of the face than in their partners, and in some flies, as *e.g.* the smaller House Fly (*H. canicularis*), the eyes of the males come completely into contact on the forehead, those of the females remaining some distance apart. Flies whose eyes meet in this way are said to be "holoptic" (whole-eyed).

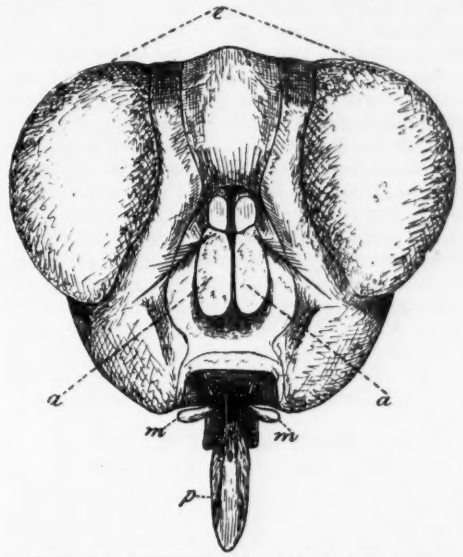


Fig. 5.—Head of Bluebottle, the hairs having been removed. *e.* eyes; *a.* antennæ; *p.* proboscis partly unfolded; *m.* maxillary palpi.

On the summit of the head, or crown, as it is called, there is a small raised area, in which are situated three shining hemispherical knobs, of a ruby-red colour. These are the simple eyes, or "ocelli" (Fig. 6). They are placed so as to form a triangle with the apex pointing forwards, an arrangement in which flies resemble bees, wasps, and other Hymenoptera. In the centre of the triangle two stout bristles stand more or less erect, like guardians of the ocelli, as perhaps they are, and others, larger still, stand facing one another at the sides,

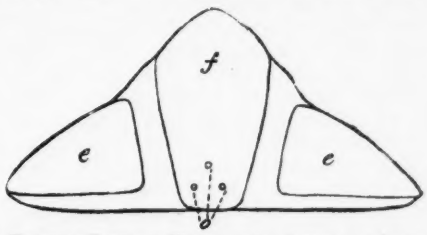


Fig. 6.—Profile View of Head from Above. *f.* face; *e.* eyes; *o.* ocelli.

forming the commencement of two rows, which run down the face. Quite a forest of much smaller bristles rise amongst the ocelli, forming a sort of brushwood undergrowth to the large ones. As these bristles readily break off, they can only be seen in their perfection in comparatively fresh specimens. It is a curious fact that the large bristles are very constant in their arrangement and position, so that names have been assigned to them, and the plan of their distribution has been called by Osten-Sacken "chætotaxy" (*i.e.* bristle arrangement). There are several groups of flies that are entirely devoid of these bristles and it has been pointed out that those flies that possess them are far less cautious in their flight than those that are without them; and as an instance of this we may

refer to the headlong way in which a bluebottle dashes about, flinging itself often with great violence against the window-panes. On the other hand, a bristleless fly would proceed much more cautiously, and would be given, which a bluebottle is not, to poising itself in the air on the wing; the best example of this may be seen in the beautiful yellow-banded "hoverer flies," as they are sometimes called (*Syrphidæ*), which delight to hover round flowers, maintaining themselves in one position by an extremely rapid vibration of the wings, which gives them the appearance of a distinct dark body, surrounded by a sort of misty halo. Now the flies that have no bristles rarely use their legs for locomotion; they fly rather than run from place to place; whereas the bristly flies use their legs quite as readily as their wings, and hence run more risk of collisions with other objects than do those whose time is spent chiefly on the wing. In consideration of these distinctions, it has been suggested that the bristles are protective in function, and serve as a sort of buffer in case of collisions. Whatever may be thought of this idea, the constancy of both number and arrangement of these bristles in the species in which they occur seems to indicate that they have some important function to fulfil in the economy of the insect.

Below the platform on which the ocelli are situated, there is, in the female, a broad flat area between the compound eyes, which slopes outwards and forms the ascent to the summit of a conical protuberance, which is best seen when a profile view of the head is obtained from above (Fig. 6). It is a kind of avenue, bordered on each side by the rows of bristles above referred to. In the male, and more particularly in those species which are holoptic, this avenue is, of course, largely encroached upon by the eyes, and in the latter case becomes merely an elongated triangle. Below this bordered avenue is a considerable depression, the outline of which is egg-shaped; at the upper and narrower end of this are attached the antennæ (Fig. 5), which are of a most peculiar form, quite characteristic of the particular section of the fly order to which the bluebottle belongs.

Each antenna consists of three joints, the two basal ones being short and conical, and the outer one long and parallel-sided and far larger than the others. Near the end of this nearest the head, springs, at an angle, a sort of feathery plume, consisting of two or three minute joints followed by a long tapering bristle, from the sides of which project other similar but smaller hairs. This style of antenna, viz., three joints and a terminal bristle, is the usual type amongst a large section of the order Diptera, which, from the shortness of the organ, are called Brachycera (short-horns), the other division, Nemocera (thread-horns), containing only the gnats, mosquitoes, daddy longlegs, &c., in which the antennæ are of the ordinary tapering, hair-like type. In the bluebottle, the terminal joint of the antennæ is exceptionally large, and is probably connected with the wonderful acuteness of the sense of smell which distinguishes the species. Its whole surface is crowded with tiny hairs, and between these the skin is covered with enormous numbers of extremely minute clear dots, some 17,000 or 18,000 having being estimated by Lowne as the number for each antenna. Scattered amongst these are also a few larger ones of a similar character; they are minute pits, the larger of which at least are in communication with nerve-threads.

That antennæ may be organs of smell seems to be indicated by experiments on the part of several observers. Take, for example, one of Sir John Lubbock's. Speaking of an ant which had been tethered to a board, he says:—"I approached the feather of a pen very quietly, so as almost to touch first one and then the other of the antennæ, which, however, did not move. I then dipped the pen in essence of musk and did the same; the antenna was slowly retracted and drawn quite back. I then repeated the same with the other antenna. If I touched the antenna the ant started away, apparently smarting. I repeated the same with essence of lemon, and with a second ant. The result was the same." Now when we remember the annoying cleverness bluebottles manifest in finding out where the meat safe is kept, and that too, not merely should the meat be actually becoming tainted, and therefore distinctly odoriferous, but even before, with our blunter senses, we can detect any odour at all, except on close approximation, it seems clear that the olfactory sense must be highly developed. When again, bearing this in mind, we notice the exceptional development and peculiar structure of the third joint of the antennæ, and couple with this such experiments as that referred to above, it seems highly probable that the antennæ, of whatever other use they may be, at least serve the bluebottle in lieu of a nose. The very position of the antennæ, too, in front of the face, gives the fly an advantage in following the scent, and thus we may think of this hyæna of the insect world pursuing its hunt for carrion, and, blood-hound-like, following the trail by trusting to the guidance of its antennal nose, searching for that which is not

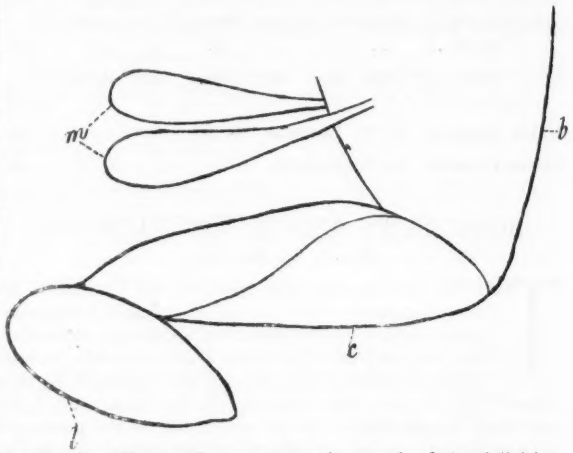


Fig. 7.—Side View of Proboscis, partly opened. *b*. basal division. *c*. central division; *l*. labellæ; *m*. maxillary palpi.

merely to serve as temporary food for itself, but also, and chiefly, as permanent subsistence for its progeny.

All the lower part of the face is red, and the two bulging cheeks are thickly whiskered over with black bristles. Below the hollow in which the antennæ are lodged is a wide groove (Fig. 5), which receives the mouth-organs when they are not in use. These are all in one piece, the so-called "tongue" or "proboscis," which is hinged to the head at the hinder part of the groove. As it is gradually opened out, the two bright reddish club-shaped maxillary palpi are seen guarding the aperture. The proboscis itself consists of three regions (Fig. 7), the basal part by which it is hinged to the head, a central part bounded above and below by hard chitinous portions, and thirdly the two flexible lobes which form the extremity of the whole organ, and are called *labellæ*; these will, of course, be closed up like the leaves of a book, and their true shape and exquisite structure cannot be made out in this position. Each lobe contains about thirty channels, some of which spring from an inner marginal tube on

each side, and all are open to the air by a narrow groove along the under surface. Their form is maintained and their walls kept in position by numbers of incomplete chitinous rings, in the form of a curve, pointed at one end and forked at the other (Fig. 8 A); these are placed alternately in opposite positions, so that, on each side, the forked ends of one series alternate with the undivided ends of the other. This arrangement gives the channels somewhat the appearance of breathing tubes or tracheæ; they differ, however, in being open on their ventral faces, and in having the strengthening rings not merely incomplete and unconnected with one another, but also much stouter and farther apart than would be the case with tracheal tubes. On account of their superficial resemblance to the latter, however, they are called *pseudo-tracheæ*. The photographs in our last paper show their microscopical appearance. They are, of course, not breathing organs, but serve as a sucking and straining apparatus, for conveying to the mouth the juices on which the fly feeds.

They communicate either directly, or indirectly through the two inner marginal tubes, with the mouth, whence they can receive a supply of saliva to be used in moistening the object which is to yield nutriment and dissolve whatever soluble matter it contains, the resulting liquid being

FIG. 8.—A. ring of pseudotrachea; B. tooth of bluebottle.

then conveyed along the channels to the mouth. For example, when a housefly brings its proboscis down on a lump of sugar, saliva is poured out and dissolves a little sugar, and the syrup is then sucked along the pseudotracheæ into the mouth, which is situated at the junction of the two labellæ. Similarly the juices of flesh, whether cooked or uncooked, can be extracted by the bluebottle. The supply of saliva is very copious, and the glands which secrete it are correspondingly large, extending right down into the abdomen. If a fly be held between the fingers so that the movements of the proboscis can be seen, there will soon be observed a clear drop of saliva collecting over the inner surface of the labellæ, and retained there partly by the aid of numerous hairs round the edges.

But there is at the same time another set of organs used in the taking of food, consisting of some fifty or sixty forked rods called "teeth" (Fig. 8 B), placed in a radiating manner just round the mouth. When the labellæ are closed, or only partially open, the teeth are concealed between their folds, and cannot therefore be brought into use. But when the labellæ are opened to the fullest extent they are used for rasping the surface of the food, thus aiding in exposing new surfaces to the action of the saliva. It follows, therefore, that repeated attacks of the teeth and the tips of the chitinous rings of the pseudotracheæ upon any delicate surface must produce numberless little scratches and asperities which will be more or less detrimental to the aspect of that surface. This, quite apart from fly-spots, *i.e.* dabs of excrement, is a source of damage to pictures, the covers of books, or other objects the exposed surfaces of which are delicate enough to receive impressions from such engraving tools as the fly's proboscis carries. The extreme flexibility and power of movement the labellæ possess can easily be observed by holding the fly between finger and thumb, when they will be seen in incessant motion, their outline continually changing as first one part and then another is bent, now up, now down. Thus the tip of the proboscis can be closely applied to any kind of surface, into the little irregularities of which the flexibility of the labellæ easily enables it to fit. Flies, *Musca domestica* in particular, seem to have the power of extracting nutriment from the most unpromising materials, witness the perseverance with which, on a hot summer's day, they keep dabbing their proboscis down upon one's coat as they course hither and thither over its surface; for it can hardly be supposed that they would so persistently keep up the practice if they found that they derived no benefit from it.

(To be continued.)

POUCHED MAMMALS.

By R. LYDEKKER, B.A.Cantab.

IN the March number of KNOWLEDGE the reader was introduced to the three living representatives of the Egg-laying Mammals, collectively forming the group to which zoologists apply the name of Monotremes. In the present communication it is our intention to bring before his notice another and much larger group of Mammals, which form one step higher in the zoological scale, and, like the Monotremes, are characteristic of Australia and some of the adjacent islands, although having one outlying family in America. These creatures are known as the Pouched Mammals, or, in scientific phrase, Marsupials, the name being derived from the pouch (Latin *marsupium*) in which the greater number of the species carry their helpless young for a long period after they have first been introduced into the world; this peculiar method of nursing being familiar to all of us who have seen the Kangaroos in the Zoological Society's Gardens. This pouch is, however, by no means universally present throughout the group, so that it cannot be taken as the especial characteristic feature of all the members; and we are accordingly driven to find some other character which will hold good for all. Such is found in the circumstance that in all cases the young are born in a very imperfect and partially developed state, so that they look like little sacs or lumps, the young of the great Red Kangaroo not being larger than our thumb. In this exceedingly helpless and imperfect condition they are transferred to the teats of the female (which are placed within the pouch when this is present), whereon they hang without much signs of life, gradually growing as they are nourished by the milk, which is squirted down their throats by a special muscle.

In addition to this peculiarly early birth of the young, and the very general presence of a pouch, the Marsupials present several other curious structural features, into the consideration of which it is not easy to enter in a paper like the present. It may, however, be observed that they differ from other Mammals in the circumstance that when milk-teeth (as the temporary set of teeth which occur in the human infant are termed) are developed there is only one such tooth in either side of each jaw, corresponding to the last milk-tooth of the child. It appears, indeed,

XUM

that we have here the first commencement of the development of a series of milk-teeth, which, in their full stage, as seen in the child, are intended for use during the period that the jaws are increasing in size; so that the permanent set may be of larger size than would otherwise be possible. The absence of a full series of milk-teeth at once indicates the low organisation of the Marsupials; and this is fully confirmed by the structure of their brain and many other parts of the body.

As we have already observed, the Marsupials are mainly confined to the Australian region, the only exception being the Opossums of America; and not only are they mainly confined to that region, but they are the only Mammals found there, with the exception of a few Bats, two or three rat-like Rodents, and the remarkable native Dog, or Dingo, the latter having not improbably been introduced by human agency. This remarkably circumscribed area of distribution would of itself lead us to conclude that the existing Marsupials are survivors of an old and therefore meet with remains of fossil species of the American group of Opossums. These data indicate that Marsupials were widely spread over the globe at an early period of the world's history, and while the greater number of types disappeared from both the old and new world to find a refuge in Australia, the Opossums lingered on for some time in Europe, but finally retreated to America, in the southern portion of which continent they are represented by a considerable number of species. At the time that Australia was cut off from land communication with the rest of the world it is probable that the higher types of Mammals—such as Carnivores (Dogs, Cats, Weasels, &c.), Rodents (Rats, Hares, &c.), and Ungulates (Horses, Cattle, Elephants, &c.)—had not yet come into existence, and these types were accordingly never able to obtain an entrance into that island-continent. Thus protected from the competition of the higher Mammals, the Marsupials have there developed a large number of types differing very widely from one another in external appearance,

Fig. 1.—Parry's Kangaroo.

lowly type of Mammalian life, since so many of the products of Australia and New Zealand are so utterly unlike those of other parts of the globe, and present affinities to types long extinct elsewhere. Thus, in Queensland alone, we have the peculiar fish known as the Barramunda (*see* Knowledge for December 1889, p. 25, Fig. 3), which is the direct survivor of fossil fishes found in the oldest secondary rocks of Europe; while in New Zealand the scarce Tuatara Lizard is almost equally closely related to fossil Lizards of the same European rocks. These *primâ facie* conclusions as to the antiquity of the Marsupial type are fully borne out by actual facts, since the secondary rocks of England, such as the well-known Stonesfield slate of Oxfordshire, and the Purbeck beds of Hampshire, have yielded jaws of a number of small fossil Mammals, many of which were evidently very closely related to some of the living Australian Marsupials. In the Eocene, or lowest portion of the Tertiary period, Australian types of Marsupials seem to have disappeared from Europe; but we there although in all cases retaining the features peculiar to the order; and we shall now proceed to notice very briefly a few of the more striking forms.

The earliest evidence of a Marsupial of the Australian type brought to the notice of Europeans was far back in the last century, when one of the animals known as Phalangers (which the Australian colonists will persist in calling Opossums) was captured in the island of Amboyna—an outlier of the Australian region—and described by a naturalist. The state of zoology at that date was, however, far too imperfect to admit of the importance of the discovery meeting with due recognition.

A more important discovery was, however, made in the year 1770, during one of the voyages of the great Captain Cook, when Sir Joseph Banks and others of the party landed on the coast of New South Wales, and for the first time were made acquainted with the now well-known Kangaroos. The species which was then first revealed to the eyes of Europeans was the largest of the group, and

is commonly known as the Great Red Kangaroo; but many other species have been since observed, one of which is figured in the accompanying woodcut. We can well imagine the astonishment with which Banks and his party gazed for the first time on the herd of Kangaroos in their native wild; the strange form of these creatures, with their long hind limbs, short fore paws, and enormous tail, together with the huge leaps by which they progress, marking them out as totally different from any Old World animal. The Kangaroo may, indeed, be regarded as what naturalists term a very specialised kind of animal, since we find several more or less nearly allied creatures, in which the fore and hind limbs were not so disproportionate in length, and which therefore depart less widely from a normal type of structure. The advantage of the leaping mode of progression and the upright position of the body to the Kangaroo appears to be that the young can thus be much more safely carried in the pouch during the long journeys that these animals are compelled to take across the Australian wastes, in search of water, than would be the case if the body was placed in the ordinary horizontal position.

Kangaroos are members of one primary group of Marsupials mainly characterised by the form and arrangement of their teeth. Thus the front or *incisor* teeth, as they are technically called, are of a chisel-like form, and separated by a considerable interval from the hinder or grinding teeth, as is well shown in the accompanying figure (2). There is only pair of these incisor teeth in the lower jaw—or at all events only pair which is of any functional importance—while, as in the figure, there are usually three pairs of such teeth in the upper jaw. From the presence of this single pair of lower cutting teeth, the Marsupials of this group are known as Diprotodonts (two front teeth).

To this group belong the true Kangaroos, of which the largest species is taller than a man; the smaller Kangaroos popularly known as Wallabies, as well as the still smaller Rat-Kangaroos being its other members. All these creatures live on the ground, and progress by leaps; but in New Guinea and North Queensland, we meet with the curious Tree-Kangaroos, in which the fore and hind limbs are of nearly equal length, and the habits of the creatures themselves are purely arboreal. The Phalangers (Opossums of the colonists) form another family of this group, most of the members of which are nocturnal and live entirely in trees. The majority of the Phalangers simply climb from bough to bough, or hang suspended by their prehensile tail; but some species, —hence termed flying Phalangers—have a fold of skin connecting the limbs, and are thus enabled to take long flying leaps from tree to tree, like the flying Squirrels, to which they present an extraordinary external resemblance. These creatures afford, indeed, a remarkable

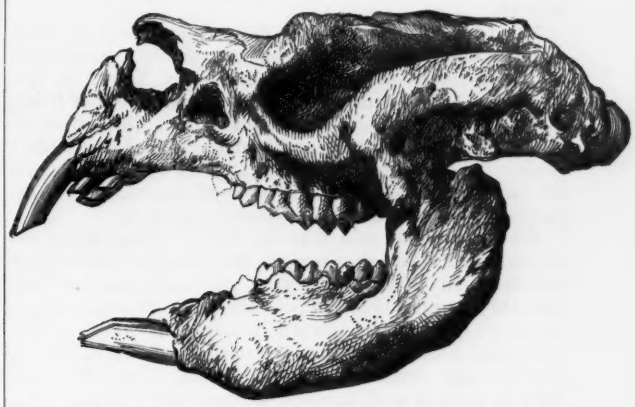


Fig. 2.—Side View of the Skull of a gigantic extinct Kangaroo-like Animal. One-tenth the natural size.

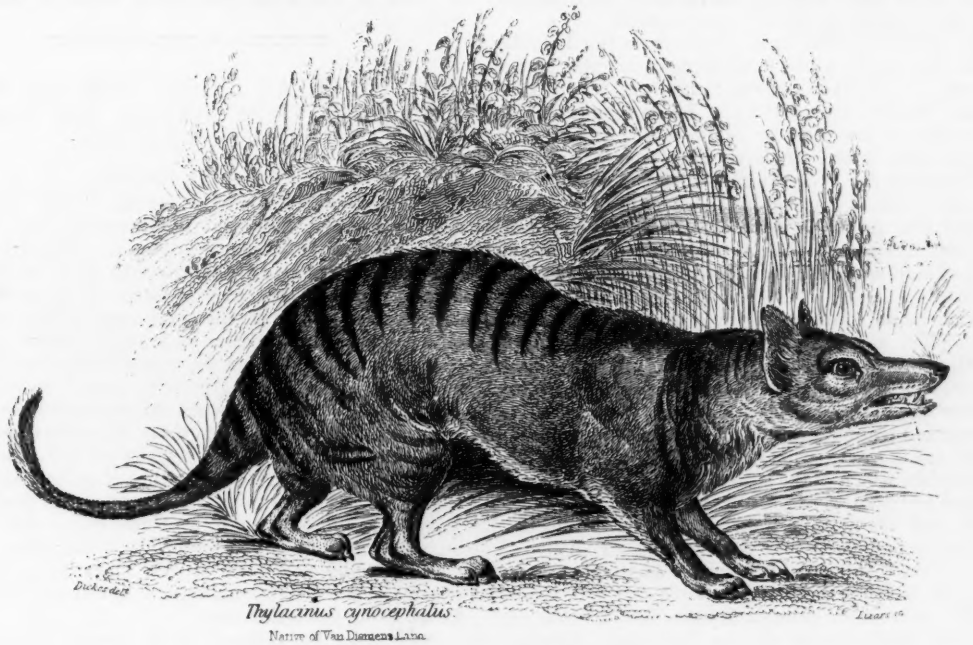


Fig. 3.—The Australian Thylacine.

instance how the same place in the *rôle* of nature may be occupied by totally different groups of animals, which, from the necessary adaptation of their structure to the same mode of life, attain a more or less close similarity of form.

Allied to the Phalangers is the curious Koala, a stout clumsily built creature somewhat resembling a small bear, by which name it is indeed commonly known to the colonists. The Wombats which are the only other living representatives of the Diprotodont group, differ from all the other forms in having only a single pair of upper front teeth. These animals are about the size of a Badger, and are furnished with immensely powerful claws, with which they dig the deep burrows in which they dwell.

We have already said that the largest living Kangaroo is somewhat taller than a man, but some of the extinct species found in several parts of Australia attained considerably larger dimensions. All these creatures were, however, comparative dwarfs besides the huge extinct Australian animal of which the skull is shown in Fig. 2. This animal technically known as the *Diprotodon*, was fully as large as a Rhinoceros, and was allied in the structure of its teeth to the Kangaroos; the fore limbs were, however, nearly as long as the hind ones, so that the creature doubtless walked in the ordinary manner.

The whole of the Diprotodonts, both recent and fossil, are confined to the Australian region, so that we must regard them, in all probability, as a specialised offshoot which has arisen there from the ancestors of the following and more generalised group to be now noticed.

All the remaining Marsupials differ from the Diprotodonts in that their teeth form a more regular series, without any very marked interval; the front teeth being small, and flanked laterally by a larger conical tooth corresponding to the tusk, or *canine*-tooth, of the dog. The hinder teeth, moreover, have sharply pointed crowns, and are adapted for a carniverous diet. There may be as many as five front (incisor) teeth on either side of the upper, and four in the lower jaw; and from this large number of front teeth it has been proposed to call this assembly of Marsupials the Polyprotodont (numerous front teeth) group.

We take, as an example of the group, the Tasmanian Thylacine (Fig. 3), commonly known to the colonists as the Wolf. The latter name, as well as the Latinized Thylacine (Pouched Dog), is applied to this animal from its peculiar dog-like appearance, which is especially shown in the long and pointed muzzle, the general contour of the body, and the long tapering tail, like that of a pointer. The Thylacine, which is the largest of the Polyprotodonts, may indeed be regarded as playing the part of the wolf in Tasmania, and the damage inflicted by it on the flocks of the settlers is, or was, very considerable. Equally destructive is the smaller animal known as the Tasmanian Devil, which is more like a large cat in size and appearance. The civet-like animals known as Dasyures are allied forms ranging over all the Australian mainland, where they are the largest carnivores. Another family of Polyprotodonts is represented by the elegant little creatures known to the colonists as Bandicoots, some of which are not larger than a mouse. A larger species, known as the Rabbit-eared Bandicoot, has long hind legs, and leaps somewhat after the manner of a kangaroo.

The most interesting of all the Australian Polyprotodonts is, however, the so-called Banded Anteater, since this animal makes the nearest approach to the extinct Marsupials of the Secondary rocks of England. This elegant little creature, in which the back is marked by alternate light and dark transverse stripes, feeds on ants, which it gathers up by means of its long and slender tongue. With the exception of certain forms, such as the Dolphins and Porpoises, which have a great number of simple conical teeth, the Banded Anteater has more teeth than any other living mammal; and it may be looked upon as the most ancient type of mammal now living upon the globe.

The only other Marsupials are the Opossums of America, which are readily distinguished by the absence of a pouch in which to carry the young. In consequence of this, the young of some species are carried upon the back of the female, with their tails tightly twisted round the tail of their parent, which is arched for this purpose over its back. All the Opossums are of carnivorous habits, while the Crab-eating Opossum is peculiar in being partly aquatic. As we have already said, Opossums are most abundant in South America, where the mammalian fauna is mostly of a low grade of organization; and they make their first appearance in the Eocene Tertiary of Europe.

Such, very briefly, is the history of the Marsupials of the present day—a history deeply interesting to the zoologist as showing how, humanly speaking, a type of animals, characteristic of an early part of the earth's existence, has been preserved to us in one remote region by the complete isolation of an island-continent, and in another by the retiring habits of its representatives and the absence of severe competition in the struggle for existence. On a future occasion we may give an account of some of the fossil Marsupials found in the English rocks.

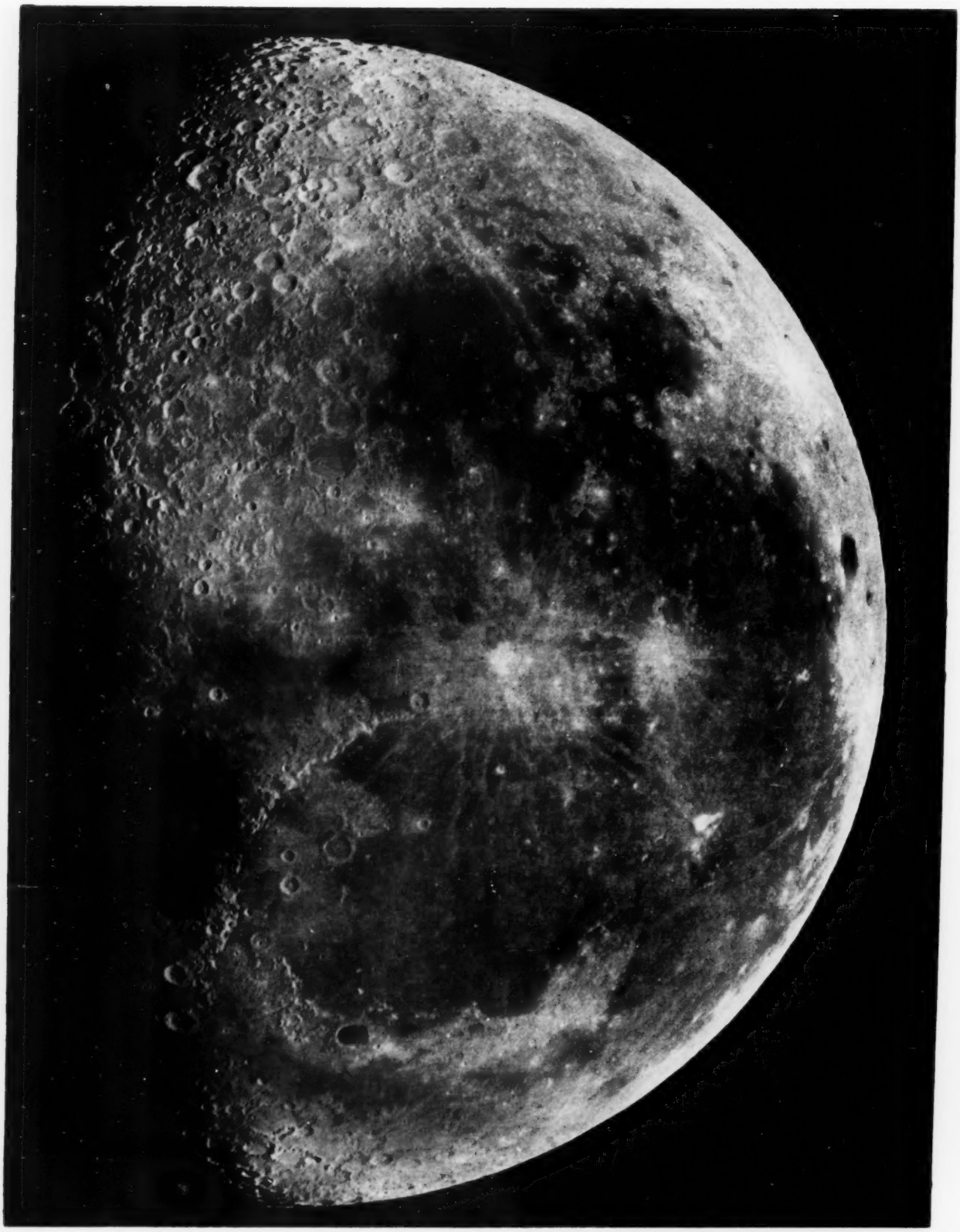
ON THE GREAT BRIGHT STREAKS WHICH RADIATE FROM SOME OF THE LARGER LUNAR CRATERS.

By A. C. Ranyard.

THE systems of bright streaks which radiate from some of the great lunar craters have been the subject of much speculation. There seems to be nothing at all analogous to them on the earth's surface. We have volcanoes which correspond on a diminutive scale with the giant craters that have grown on a globe where the force of gravity is only one-sixth of the gravitating force that has controlled the building of our terrestrial mountains. But with regard to most of the other lunar features, terrestrial analogies are wanting perhaps more completely than is ordinarily realised. There is no difference in the colour of the lunar equator and poles indicating the existence of polar caps of snow that wax and wane with the lunar winter and summer. We are therefore driven to conclude, either that there are no snow-fields on the moon, or that the polar caps have advanced and coalesced at the lunar equator. I gave reasons in the October number of Knowledge of last year for adopting the latter view.

Seen from the distance of the moon, the earth, or as much of its surface as could be seen through its ever-shifting mantle of clouds, would appear highly tinted or coloured with patches of different hue; there would be a difference in the general colour of the continents and of the oceans, and we should expect that the Sahara would not appear of the same tint as the green fields of northern Europe. The advent of spring would certainly make itself apparent by the bursting into leaf of the trees, and the greener tint of hills and dales—and possibly also the flowering of the buttercup and the crocus would be an event that might be seen and speculated upon by the lunar watcher. But we see no seasonal changes, whether

XUM



Enlarged from a Photograph of the Moon taken with the Great Refractor of the Lick Observatory.

In the original negative the Moon is about five inches in diameter.

XUM

annual or monthly, upon the moon, though there are striking differences in brightness between different regions which remain pretty constant the year round, and are very much the same when the sun sets on the lunar landscape, after the fortnight of exposure to sunlight, as they were when the sun had just risen after the fortnight's exposure to the cold of night. Slight changes of tint have been reported—parts of the *Mare Crisium* have been said by some observers to become reddish, and parts of the *Mare Serenitatis* greenish; but the colour is not at all marked, and its existence is even doubtful.

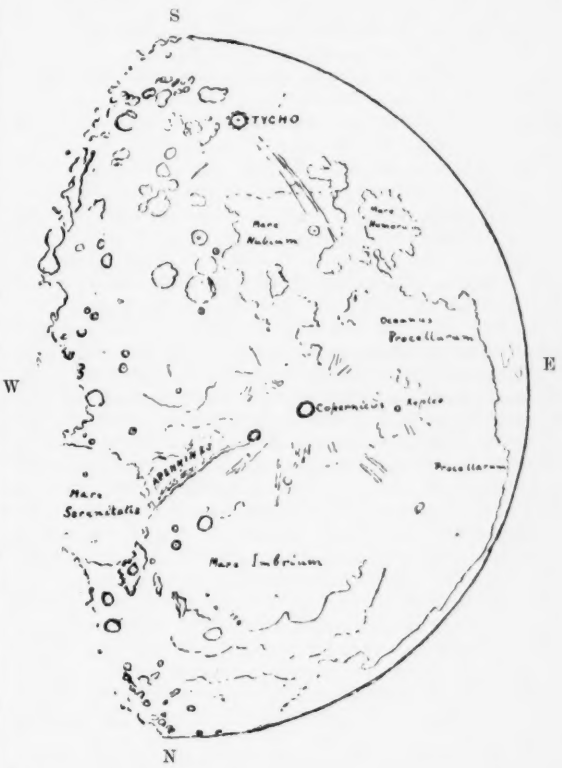
We must not picture the moon as covered with a sheet of snow as spotless as that which covers the summit of Mont Blanc. For the full moon only reflects 0·1736 of the sunlight which falls upon it, while clean snow reflects more than three-quarters of the incident light, according to Zöllner's measures 0·783; perfect whiteness being reckoned as unity.

The very great difference in whiteness of different parts of the moon's surface is well shown in the plate that accompanies this paper. It has been made by the kind permission of Prof. Holden from a photograph taken with the great refractor of the Lick Observatory, of which a silver print copy was sent me by Mr. Barnham. It might be thought at first sight that the small dark patches, such as that below the bright spot to the east of the *Mare Imbrium*, or the four dark spots to the south of (that is above) the *Lunar Apennines* and *Copernicus*, were photographic defects; but they are discernible on all good lunar photographs, and similar but smaller dark patches may be seen in various parts of the *Mare Imbrium*, and in the darker field of the *Mare Nubium*. On this photograph they are particularly well shown, as well as the general mottling of the dark areas.

Since the light given by the full moon is about equivalent to that which would, according to the measures of Zöllner, be given by a globe of equal size of very light-coloured sandstone or pumice, it follows that the white parts of the moon, such as the mountainous regions and the whitish border which lies all along the limb or smooth edge of the moon,* must be whiter than sandstone, while the low-lying darker regions correspond in tint to darker rocks or mud, possibly of meteoric origin, or possibly partly of meteoric origin and partly due to the rubbing of glaciers, which would grind the rocks and bring down débris, as ice does here, except that the caps of mountain ice could be piled up more steeply, and would not flow with such plastic ease under the action of lunar gravity as here. But given a mass of ice upon the moon six times as thick as a similarly placed mass here, and the pressure on the bottom layers tending to make it flow down-hill would be about equivalent in the lunar and terrestrial masses. Without dogmatising as to the way in which ice-born matter worn from the mountain-sides would be deposited on a lower snow-field, we may feel sure that there would be a tendency to accumulate detritus and ice at the lower levels, and that after the lapse of ages the mountain-tops would be denuded of ice if it were not continually carried back again in the form of aqueous vapour. This seems to be the easiest way of accounting for the greater whiteness of the high land and mountainous regions. If we reject this theory we shall have to assume that the summits of the mountains are all composed of a substance as white or whiter than chalk, while the lowlands are uniformly composed of darker materials—a supposition which is too artificial to satisfy modern ideas.

* A region where only the tops of mountains would be seen, the lower ground being hidden.

The bright streaks which radiate from the great lunar craters form an exception to the general rule that the brightness of the lunar surface corresponds to the altitude of the ground, for it is certain that these rays do not correspond to lofty ridges, or even to ridges a few hundred feet in altitude; the regions across which they pass have been frequently scrutinised when the sun is rising or setting on the lunar terminator, but no ridges which cast a shadow can be detected as coincident with the streaks. They do not correspond to lava streams, for the rays run across mountains and planes, and even through the rings and cavities of old craters. No rising ground turns them aside, whereas lava streams would evidently follow the inequalities of the ground. Though best seen at full moon, when the sun is high, the rays do not seem to be brought into existence by the action of the sun's heat, for they are no brighter when the sun is setting than when it rises. They seem to correspond to a permanent difference of tint of the lunar surface, which is best seen when not



interfered with by the shadows cast by the inequalities of the lunar surface. The brightest of the rays have been seen by the faint earth-reflected light which illuminates the "old moon in the new moon's arms." It will be noticed that they are not all exactly radial from the centres with which they are evidently connected—occasionally they fork and sometimes unite again with other rays; two of the longest of them which radiate from the great crater Tycho extend to a distance of over a thousand miles from the crater. In some instances they seem to be connected with delicate surface irregularities, and, as Neison remarks, in some cases with small crater systems; but such connection is certainly not universal. They are of various breadths, though mostly only five to ten miles broad.

There has been much speculation as to what can be the cause of these rays. Nichol thought that he had sufficient proof that they are composed of matter shot up from the interior of the moon. He says: "It may seem incredible that we can solve this problem by virtually digging pits of vast depth down through these singular bands, and thus ascertaining practically that the matter composing them certainly descends towards the interior of our satellite, and that in all probability it has been forced up from the interior. The telescope, which is in this instance our *labourer*, has discovered numerous small craters of varying depth in the midst of many of the rays, and it reveals the fact that these small craters, however deep, do not penetrate through the matter we are examining, inasmuch as there comes from their bases always the same kind of light that characterizes the ray. There is one remarkable case in point. A large crater named Saussure, and not far from Tycho, lies directly in the line of a ray, and of course appears to interrupt it; but at the bottom of Saussure, notwithstanding the great depth of that crater, the ray from Tycho may be traced. Nay, there is reason to believe that in favourable circumstances the same ray might be seen rising up the sides of Saussure, just as a vein of trap or of volcanic rock pierces the sedimentary strata upon earth. What, then, can we make of such phenomena? Are not our terrestrial trap-dykes or veins their fitting similitudes?"

Nasmyth was of opinion that the radiations "are cracks divergent from a central region of explosion, and filled up with molten matter from beneath." He gave a lecture some twenty years ago, at the Royal Institution, at which he made a glass globe fly into radiating cracks, by filling it with water, which he was able to force into it with a small pump. The globe was then touched with the tail of a file, and flew into fragments, much in the same way as a window-pane breaks when struck sharply by a stone. The Rev. T. W. Webb, with whom I attended the lecture, remarked that he could conceive of a comet playing the part of the tail of the file; but he could not conceive that there could be any true analogy between the strains in a thin glass globe and those in the crust of a sphere 2,000 miles in diameter. In his excellent chapter on the moon, in the *Celestial Objects*, he rejects Nasmyth's theory, because he conceived that faults or radical trap-dykes would give rise to a "visible deviation of the superficial level," and "the chances against so general and exact a restoration of level all along such multiplied and most irregular lines of exposure would be incalculable; many of the rays are far too long and broad for this supposition, or for that of Beer and Mädler, that they may be stains arising from highly-heated subterraneous vapour on its way to the point of escape."

Proctor seems to have favoured the trap-dyke theory. Neison, after carefully setting out the observed facts, refrains from advancing any theory, and concludes his account of the rays with the remark that "the true solution of the origin of these streaks or rays will probably not be found until their appearance has been made the subject of a thorough investigation, so as to make known the more delicate features they present," and Young, in his recently published *General Astronomy*, concludes his account of the rays with the remark that "we do not know whether they are like the so-called trap-dykes on the earth—fissures which have been filled from below with some light-coloured material—or whether they are mere surface markings. No satisfactory explanation has ever been given."

A very fanciful theory has been put forward by Mr. S. E. Peal, a tea-planter of Asam, who has published a book entitled *A Theory of Lunar Surfacing by Glaciation*, which contains many bold, and, in some cases, very ingenious speculations. Without endorsing Mr. Peal's statement that many of the rays join two volcanic centres, it may be well to state his theory. He considers that "the rays are the tracks of electrical surface discharges, often between active foci. They do not appear as an irregular hatching all over the surface, as though due to the grazing of meteors, but always show as radiations from some active centre, and often as passing out direct to another centre. If this view is correct, they confirm the supposition that the outer surface is a snow surface stained by an accumulation of meteoric dust, which the electrical discharge removes *en route* and thus exposes the cleaner snow surface, with a minimum of mechanical, giving a maximum of optical effect. . . . That electrical phenomena on the grandest scale are generally seen in connection with volcanic displays on our earth is well known."

It is clear that the rays have some connection with the volcanic centres from which they radiate, and the speculation which commends itself most to my mind, is that they correspond to a series of radiating cracks or faults from which comparatively warm air issues, charged with aqueous vapour which is deposited as hoar frost on either side of the vent. We know that on the earth the atmosphere enters the interstices of the soil, and that on every fall in barometric pressure it rushes forth again, laden in many mines with gas, while it probably issues everywhere from the spongy soil laden with moisture. We should expect that the moon's atmosphere, however rare it may be, would fill the interstices of the lunar soil to great depths; and if we may assume, as we almost certainly may, that there is an increase of temperature as we go down within the moon, at all similar to the law of increase which holds good upon the earth, the air would grow denser and warmer as we proceeded downwards below the moon's surface.

We know that hot air takes up more moisture than cold, and we should expect the air as it became warmer to take up moisture from the soil, that is if the soil was not absolutely dry, and that any air that issued from vents would contain more moisture than the cold air at the surface. As the issuing air cooled by radiation, we should expect that it would deposit its moisture either as snow or hoar frost.

Without speculating as to the amount of inspiration and expiration that would be caused monthly in the great lunar lung by the change of temperature between the fortnight of day and night, or by the fortnightly passage of the atmospheric wave due to the solar tide, we may be confident that convection currents would be set up as surely and as certainly in every vertical vent upon the moon as they are in a terrestrial laboratory, carrying warm air to the surface, when it would deposit the moisture it had picked up on its warmer underground travels.

Besides the radiating white streaks there are several white spots upon the moon, some of which are very brilliant though they do not correspond to very high ground. They usually coincide with the area of a crater, or they have a small crater at their centre. On the above theory, the white spots may be assumed to lie around a volcanic vent or chimney, from which warm air charged with water vapour issues.

Owing to the feeble action of lunar gravity we should expect cavities in the soil, cracks, and vents, to have larger dimensions upon the moon than on the earth, for their size is evidently controlled by the weight as well as by the

strength of the rocks surrounding them. Some writers speak of the dark linear markings on the moon, known as hills or clefts, as if they were cracks in the lunar crust extending to a great depth. Neison has noted that many of them commence at the end of a system of branched valleys leading from high lands, whilst others can be detected winding along the bottom of extensive valley regions, and he has suggested that they mark the path of water drainage from higher levels—a view in which Webb was inclined to concur with him. Webb, Schmidt, and Neison all speak of the rills as if they were comparatively shallow valleys. They are not seen when the sun is high as they would be (owing to the black shadows cast in them) if they were many miles in depth. Even with the feeble action of lunar gravity, it is difficult to conceive of vertical precipices many miles in height that are not supported at close intervals by opposite walls, as in the case of our terrestrial faults. No black clefts or cracks are seen extending along the centres of the bright streaks which radiate from the great lunar mountains, but such cracks would not be seen by us unless they were at least a quarter of a mile broad.

Mr. Webb's difficulty in understanding how the surface level should be so little disturbed if the rays corresponded to great lines of faulting, is connected with ideas derived from terrestrial faults caused by the subsidence of strata; but these faults must evidently be connected with some volcanic strain or upheaval at the centre from which they radiate. It must have occurred to many theorisers to suggest that the rays may have been caused by the impact of some great meteoric body which has cracked the lunar crust as a pane of glass is starred by a stone; but if this were the case, the place of the blow is always curiously coincident with a regularly formed volcanic crater very similar in form and appearance to other lunar craters; and it will hardly be argued that the mark of the blow has chanced to be obliterated by a crater which has formed there since, for there are certainly seven such ray systems all with craters at their centres, namely, Tycho, Copernicus, Kepler, Byrgius, Anaxagoras, Aristarchus, and Olbers.

I showed in the October number of Knowledge for last year that the phenomena observed during total solar eclipses and occultations of stars at the limb of the moon prove that there certainly is not as much air at the moon's surface as there is at a height of thirty-two miles above the earth's surface. Most of the shooting stars that we see become visible in our atmosphere at a height of about 100 miles, and they mostly disappear before they reach a height of seventy miles above the sea level. It is a very brilliant meteor which gets down to a level of fifty or sixty miles without having been driven into vapour, and the velocity of even large meteors is greatly reduced before they reach the lower strata of our atmosphere.

If the moon were entirely without an atmosphere, or even if there were only as much atmosphere at the lunar surface as exists at a height of 100 miles above the earth's surface, the weathering action caused during long ages by the bombardment of meteoric particles would certainly be very considerable; for the force of a blow struck by a projectile varies as the square of the velocity, and small projectiles moving with a velocity of twenty to forty miles per second would penetrate deeply into the rocks they struck, bringing down fragments, large compared with the mass of the bombarding fragments. The existence of lofty precipitous cliffs on the moon is sufficient evidence that there must be some covering of atmosphere sufficient to afford a protection from such bombardment.

Since the commencement of the year Prof. S. P. Langley has, in conjunction with Mr. F. W. Very, published a third important memoir on the Temperature of the Moon, as determined with the bolometer, a very delicate heat-measuring instrument contrived by Prof. Langley. The memoir shows that two distinct heat maxima are observable in the lunar spectrum, one corresponding to the radiations reflected from the lunar soil, and the other to those emitted by it. The position of the maximum of the heat-spectrum furnishes a reliable method of measuring the temperature of a radiating solid body in the laboratory. And if it were not for difficulties introduced by the unequal absorption of the earth's atmosphere in different parts of the spectrum, which atmospheric absorption varies from night to night, and which can only be approximately determined, the heat of the lunar surface might, no doubt, be measured to within a degree or so centigrade. As it is, Messrs. Langley and Very believe that they have evidence that the maximum temperature of the sunlit soil in the neighbourhood of the lunar equator is only a little above freezing, while the temperature of the moon's poles is far lower, and measures of the unilluminated part of the moon have failed to show any traces of heat. I have already far exceeded the limits of an ordinary paper, and I must defer to another occasion an explanation of Prof. Langley's methods and results, and a comparison of them with the Earl of Rosse's measures of lunar temperature, which, though very carefully made, I now believe to have been founded on a mistaken assumption.

VENOMOUS SPIDERS.

By A. J. Field.

It does not seem to be generally known that spiders are provided with a poison of a very active nature, the effects of which are similar to those produced by snake-poisons. It is true that the spiders found in England are small and quite harmless to man; but it is probable that some poisonous fluid is secreted in the mandibles of all spiders—even the bite of the common house-spider (*Tegenaria domestica*) is quickly fatal to flies and other insects on which it preys. Spider-poison appears to have special effects on certain insects, and the largest flies are not always the least affected by it. Insects over which spider-poison has but little influence are usually left meshed in the web to struggle until exhausted before the spider attempts to devour them. When a fly is bitten by a spider its whole body seems seized by violent convulsive twitchings, and death generally occurs after a few minutes. The spider's poison issues from a sac and duct at the base of its mandibles; it closely resembles the venomous matter secreted by scorpions, and is a transparent fluid, containing traces of fornic acid and albumin; there seems to be nothing characteristic in its microscopic appearance. When it is collected from the poison-glands of several spiders and dried, it will retain its physiological properties for many years, and even after it has been subjected to a boiling temperature its properties are not destroyed. The spider is provided with a most effective apparatus for injecting its poison, consisting of modified mandibles, called falces, the last joint of which has a hard curved fang, with a fissure near the point. The muscles used in closing the mandibles also press upon the poison-gland, causing the poison to be expelled through the fissure into the wound, and thence into the circulation of the victim.

The reader should watch a common house-spider spin its web. It seems to take pains, before beginning, to select

XUM

a spot where there are chances of obtaining plunder and where it will be secure. It then discharges a little drop of glutinous fluid, and creeps up the wall, joining the thread from one wall to the other. The first thread thus formed is drawn tight, and fixed at each end with other threads. It is upon this outer thread that the durability of the whole fabric depends. The web's foundation completed, the spider next makes a number of threads parallel to the first, and then crosses them with other threads, the sticky substance of which they are formed serving to bind them, when newly made, to each other. It now commences to double and treble the threads that border its web, securing the edges as it does so. Lastly, it forms a kind of tunnel with webbing; this is to serve as a retreat, where it can conceal itself from its enemies and also from its prey, and is generally placed in the angle of the walls. When the spider's work is done, it often happens that the approach of some large animal or the passage of the housemaid's broom will destroy in a minute the labour of days. In this case, as soon as the danger is passed away, the spider patiently begins to repair the web. For this purpose the spider is provided with a store of the glutinous matter of which the web is made. When possible, the spider prefers the mending business, as it is only provided with a limited quantity of glutinous matter, and when this is exhausted it probably cannot be renewed. Old spiders, which have neither web nor the materials to make one, often hunt about to find out the webs of other spiders, younger and weaker than themselves, with whom they venture battle. The invader generally succeeds, and the younger spider is driven out to make a new web, and the old spider remains in possession until a stronger spider invades the web and drives it out. When thus dispossessed the spider seldom ventures another attack, but tries to subsist upon the few insects that may fall accidentally into its clutches, and eventually dies of hunger. The house-spider's web is thick, of black close texture, and is usually garnished with dust and bits of plaster. The webs of spiders are in themselves an interesting study. I have endeavoured to give in the illustrations two of the most striking examples from specimens at the British Natural History Museum (Fig. 1). The cocoons of the house-spider are formed in May; they are flattish in shape, measuring upwards of three-quarters of an inch in diameter. These spiders may, with a little patience, be tamed. I once had one tame enough to come and take a fly out of my hand. The male in most cases is much smaller than the female spider, and he has to be very cautious in making love to his better-half; she does not always meets his advances with favour. De Geer says that he once saw a male while coquetting with a large female, "seized by the object of his attentions, enveloped in a web, and then devoured." "M. Vinson, too, gives a graphic account of the agile way in which the diminutive male escapes from the ferocity of the female, by gliding about and playing hide and seek over her body and along her limbs. In such a pursuit it seems probable (says the Rev. O. P. Cambridge, a great authority on spiders) that the chances of escape would be in favour of the smallest males, while the larger ones would fall early victims; and thus gradually a diminutive race of males would be selected."

Fig. 1.—Web of a Wolf Spider.

The well-known tarantula (*Lycosa tarantula*) (Fig. 2) is one of the largest, but by no means the most venomous species of spiders found in Europe. It belongs to the mining section of the family termed *Lycosidæ** or Wolf Spiders, and attains a length of three-quarters of an inch. The tarantula's body is covered all over with down, chiefly of an olive dusky brown colour. The upper border of the thorax and the outline of the eyes are yellow, and the back of the abdomen is marked with a row of triangular dark spots with whitish edges. Their eight eyes are arranged in three transverse rows, the front row containing four small eyes, while behind these are two pairs of larger eyes. During the summer months the tarantula, while creeping among the corn, bites people employed in the fields, but the bite, though painful, is seldom dangerous. Dr. Zangrilli, an Italian naturalist, who has had many opportunities, of observing people bitten by this spider, says that soon after the occurrence the part bitten becomes deadened, and in a few hours there are slight convulsive shiverings,

Fig. 2.—Lycosa Tarantula.

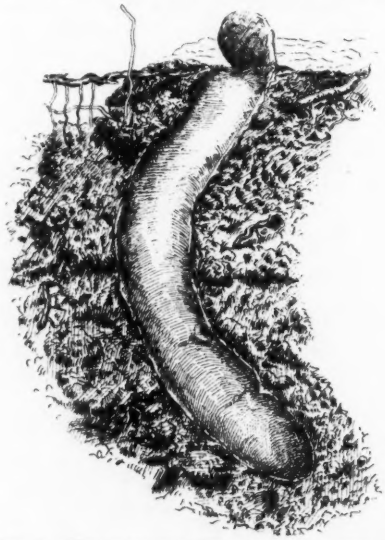


Fig. 3.—Underground Nest of a Tarantula.

cramps of the muscles, spasm of the muscles of the throat, followed by vomiting and a three days' fever. Recovery generally follows after copious perspiration, but in one case there was tetanus and death on the fourth day.

The tarantula is common in Spain, southern France, and

* Λυκος, a wolf.

Italy, occurring in great numbers in Apulia round the town of Taranto; it has been found in Asia, and also in northern Africa. The tarantula is to be found in dry places, partly overgrown with grass, and fully exposed to the heat of the sun, living in an underground passage (Fig. 3) which it digs for itself, lining it with its web. These passages are round in section, and sometimes quite an inch in diameter, often extending to the depth of a foot or even more below the surface. This spider is very quick in its movements, and eager in the pursuit of its prey, it waits only to kill one victim before it darts upon another, and it has been known to allow itself to be carried into the air by a large fly that it has attacked, rather than relinquish its hold. The female tarantula lays from nine hundred to a thousand eggs in a season, and shows considerable maternal care. When the number of eggs she has brought forth have remained for an hour or two to dry after exclusion, she prepares to make a bag for them. For this purpose she spins a web and lines the inside with down, which she plucks from her breast. Within the bag, which is almost as thick as paper, the eggs are deposited, and it is then fastened, by means of the glutinous fluid she secretes, to the end of her body. The female tarantula has never

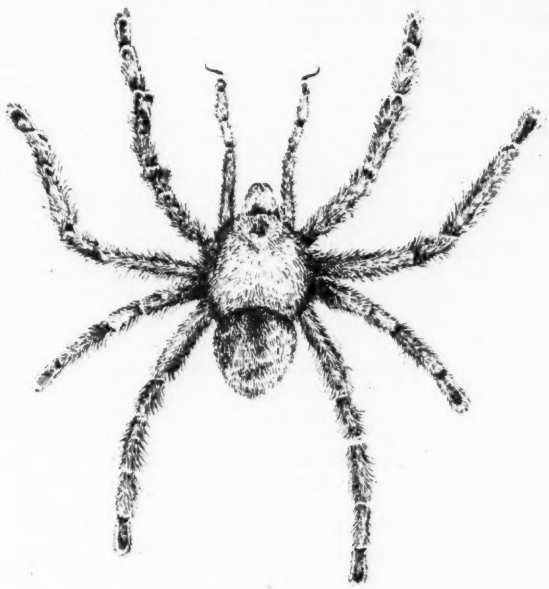


Fig. 4.—The Bird-Spider (*Mygale avicularia*).

been known to abandon her offspring until they are able to take care of themselves. She hatches two broods in the year, in spring and autumn, and has been known to hatch three. The eggs are not adherent to each other in the cocoon. When the young ones are excluded from their shells within the cocoon, they remain in this confinement until the female, instinctively knowing their maturity, bites open the bag and sets them free. The young of web-making spiders after leaving the egg immediately commence weaving, but the young tarantula (leading a vagrant life, and having no web) being incapable of protecting themselves, remain for about a fortnight with the mother, giving rise formerly to a belief that they derived their nourishment from her body.

The female tarantula has been known to sit upon her cocoon or egg-sac, and hatch the eggs; probably not by the heat of her body, for spiders are cold-blooded animals, but by keeping the heat of the eggs from passing into the colder air around.

The coya is a small red spider, or more properly speaking a mite, which contains a fluid in its body that causes tumours and very painful swellings when brought into contact with the punctured skin. In India, Sir Joseph Fayrer says, the skin is often affected with a streak of almost erysipelatous redness, which is caused by a spider, and it is very probable that it may be a species allied to the coya. Similar in its effects is the bite from a much larger creature, the bird-spider (*Mygale avicularia*). As yet little is known of its habits. Madame Merian, the lady who first described this species, said that it fed chiefly upon ants, but when it was very hungry it would drag small birds from their nests and suck the blood out of their bodies. The bird-spider (Fig. 4) is a most ferocious animal, the males fighting with great fury whenever they meet; and the females, being larger and stronger than the males, frequently devour their partners. They are armed with very sharp fangs, which inflict most dangerous wounds, disabling or killing the unfortunate animal that may be bitten. But according to Dax, a French chemist, who has written numerous works on venomous animals, the spider called *Latrodectus malmignatus* is even more poisonous than the bird-spider. Its bite produces head-ache, muscular weakness, and cramps, these symptoms lasting several days. There is a little poisonous spider confined to New Zealand which is called by the Maoris "katipo," and is probably one of the most dangerous species, its bite not unfrequently causing death. Mr. W. H. Wright describes the case of a person who was bitten by the "katipo" on the shoulder. The part rapidly

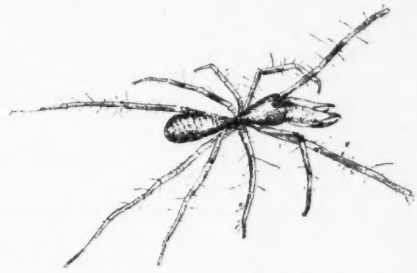


Fig. 5.—Galeodes Araneoides.

became swollen, and looked like a large nettle-rash wheal. About an hour afterwards the patient could hardly walk, the respiration and circulation were both affected, followed by prolonged muscular prostration. In this case, however, the patient recovered in a few days. Accounts are given of cases in which the bite of "katipo" produced chronic illness, death occurring after about six weeks from the accident.* The next two species of spiders I am about to mention frequently destroy human life, and it is probable that the number of reported deaths from the bites of these dangerous creatures fall far short of the actual reality. The least dangerous of the two is the *Galeodes araneoides* (Fig. 5), which is not a true spider, but has a nearer connection with spiders than have scorpions. It is found in the Russian and Asiatic Steppes, Arabia and some parts of Egypt, being represented in India by an allied species known as *Galeodes fatalis*. While walking at night-time this peculiar spider keeps its two pairs of palpi constantly in motion, and if they come into contact with anything they are said to emit a phosphorescent light.

* *Trans. of the New Zealand Inst.*, vol. ii., 1869; also the *British and For. Med. Chir. Review*, July 1871, p. 235.

A GULLY IN THE BLUE MOUNTAINS OF NEW SOUTH WALES.

By C. Parkinson, F.G.S.

TOWARDS the Emu plains the escarpment of the Blue Mountains—a hundred miles or so from Sydney—presents an almost unbroken series of precipices, and the only wonder is that the most indomitable of explorers ever succeeded in penetrating to the extensive plateaux above. Indeed, if it were not for the Nepean River and closely associated fault—which forms the line of dislocation followed by the famous Bathurst railway—no road could have here been found for the ascent of this singular mountain range. Peaks there are none. The Hawkesbury sandstones simply tower above the coastal plain, and vast gullies bisect the rugged cliffs. Dense forests cover these depressions; it is as if Sydney Heads and Port Jackson had been elevated far above the sea-level, the waters had gone back, and vegetation now occupied the valleys far below. It is quite certain that at the period when a great part of Central Australia was beneath the sea, the "Wianamatta Shales" were deposited amongst the gullies of the Blue Mountains. Sufficient indications remain to prove that beds of considerable depth have been denuded from the surface of the Hawkesbury sandstones. There has been an elevation of the mountainous plateau—perhaps in Mesozoic times, when the great fault appeared—with a corresponding retrogression of the Pacific Ocean. The gorges represent areas of depression in which the waves have rolled; but now silent forests lie beneath the precipices of a thousand feet. How many travellers have stood overlooking the Katoomba Falls, wondering how they might approach the interminable bush, fifteen hundred feet below? The only practicable route seems to be the zig-zag railway to the plains beneath; but other paths exist through the gullies, if one can but discover the way amid the labyrinth of bifurcating gorges and hidden valleys which penetrate the enormous cliffs in every direction. It is one of these stupendous ravines that I propose to describe.

Leaving the Bathurst road—ankle deep in sand—at a point where the bridle-path branches away from the carefully railed in "Explorers' tree" (the farthest distance reached by the first expedition from Sydney), let us descend into Nellie's Glen by a zig-zag path skilfully carried round the extreme edges of precipices, and protected at awkward turns by masses of vegetation and friendly tree-trunks. Into this narrow cleft the sun never shines. From the depths below, the perpendicular walls—a sheer fall of some 900 feet—are separated at the top by a thin strip of blue in the vault above: a trickling stream forms a series of cascades from the head of the profound gorge. The moist interstices of the rocks are crowded with seedling ferns such as might be seen in a hothouse at home, trailing lycopods, and luxuriant mosses. Two species of Hymenophyllum (*H. marginatum* and *H. flabellatum*) are scattered about in all directions, with fine Lomarias, a delicate species of Pteris, and noble tree-ferns overhead.

It is a novel experience to stand for the first time beneath the enormous spreading fronds of the tree-ferns, which form shady bowers amid a miniature forest. The upright stocks might be mistaken at the first glance for the trunks of some palm thickly coated with fibrous brown hairs. The crown of delicate green rises 20 feet overhead, the stem increasing in height as each tri-pinnate frond dies or breaks away from the main stock. If our homely male and lady ferns could be suddenly enlarged a hundredfold, the effect of tree-ferns in other climes would be reproduced. There is the most extraordinary vitality in the Australian species. The caudex or upright stem may be torn from the ground, the crown chopped off, and the decapitated stock transferred bodily to the coast. There it is thrown into the hold of a ship to be carried across the seas; and yet, when planted in some English hot-house, fresh fronds will unfold with renewed vigour.

Attached to the trees are numerous epiphyte ferns (*Platycerium*), not truly parasites, because the plant does not depend on the host for vitality; it merely clings to the tree. A humble little violet (*V. heteracea*) creeps amidst the moss; it has poor, purplish-white flowers, which are insignificant after our European favourites. It is late in the summer for orchids, but here and there a few still linger. *Microtis parviflora* is a marsh-loving species, with greenish spike suggestive of the British Liparis.

Lower down in the bush and scrub are marshy swamps and sandy patches covered with rank herbage. The Prickly Hakea may be seen in dense thickets, a mass of rosy bloom. Parts of the bush are a very blaze of colour, from a rich blue Lobelia which carpets the ground. The Epacridæ are among the chief glories of the island continent; those heath-like plants with nectar-laden corollas of crimson, pink and white, which appear to expand at most seasons of the year. The beauty of these and the crimson Callistemons are beyond description; they must be seen in order to be appreciated. Leguminous bushes with yellow blossoms resembling Broom are also attractive. A confusion of red threads and minute clusters of waxy flowers almost choking the growth of a small Epacris may be noted as a Dodder (*Cuscuta*), probably the indigenous species found in New South Wales.

The effect of the bush on a moonlight night is peculiar. The strips of bark wave silently in the breeze, and the white trunks gleam in the deceptive silvery rays, for all the world like gigantic ghosts sighing in restless tribulation. The moon—by the bye—is upside down in this hemisphere, and the surface markings consequently look quite different to what they are at home. At night you may be startled by a pair of sharp eyes from a shapeless mass, hanging downwards from a tree, staring at you. It is but a flying-fox in its favourite position, with knowing face and not unpleasant expression. Instead of a pouched mammal it is somewhat suggestive of a winged reptile of old, which has come to life in a far-off corner of the world. An owl-like bird flutters silently in the darkness, lightly skimming the surface of the ground. It is caught in a wire fence very conveniently for closer examination. The widely distended mouth reveals the goat-sucker tribe, which in Australia takes the place of the owls. Our *Caprimulgus europæus* is a diminutive representative of its antipodean relations, some of which are really fine birds.

Where the stream issues from the ravine there is a peaty swamp, alluring to the collector of beetles and unconsidered trifles in general. Knee deep in rank grasses, Hakea and Banksia bushes, amid all the elements of a marsh, it is a wise precaution to tread gingerly, looking out for snakes and creatures that sting; for many villainous beasts lurk and revel in the prevailing moisture. There is one hideous spider, which spins a cocoon as big as a hen's egg. The structure is interwoven with four stout blades of grass in the midst of a tussock. Finding one of these I slit the side of the webbing, only to catch sight of a striped yellow and black thing as big as a hornet, from which we fairly ran away. Curiosity soon compelled us to return; there was a great spider, possibly

a venomous Tarantula, evidently in a red-hot passion with those who had wrought havoc in her domicile. The body was more than an inch long, with legs of corresponding size and strength. Next day the slit was repaired. Mosquitoes buzz around, thirsting for blood, and scorpions may be beneath the stones.

Snakes are wonderfully few and far between. I saw a harmless Diamond snake, which is slender in proportion to its length, and exquisitely marked with varied shades of steel blue and greenish yellow, gleaming brightly in the sun. Several serpents, such as the Whip snake and Black snakes, are poisonous enough; but under the improved medical treatment gained by experience, I doubt if a necessarily deadly serpent (such as the Cobra, for instance) exists in Australia, unless it be in tropical Queensland. More persons recover than die from snake bites; and given a fairly healthy constitution, with proper remedies quickly applied, a case need not be fatal.

Half a dozen species of Sundews grow in the bog, *Drosera spatulata* closely resembling the English *D. rotundifolia*, some having white and others deep rose-coloured flowers. *D. auriculata* grows on a spiral stem, with crescent-shaped leaves all crimson with hairy glands; the terminal flowers are larger in size, and white. The tiny rosettes of *D. pygmæa* carpet a bank in dense clusters, and *D. peltata* has bulbous roots like miniature radishes, each green leaf—with few dark brown hairs—having a radical stem. *D. binata* has dichotomous leaves, the linear divisions spreading from the stem like a horseshoe. The plant lies hidden among grasses or wet moss, ready to capture unsuspecting prey. It is highly sensitive to whatever touches the irritable glands, and beyond a doubt snares unwary insects. To test the matter more completely, I lightly placed a large ant (that black species with heavy protruding jaws, known as the "Bull Dog Ant"), by means of a piece of stick, near to the centre of a leaf. The sticky secretion on the hairs was hardly sufficient to hold so powerful a creature, but another action of the plant was at once commenced; the ends of the leaf slowly folded towards the central stem, thus firmly imprisoning the struggling prey. I carried the Drosera, with some damp moss, to grow in a saucer for a few days. Within the week every atom of nutriment had been extracted, and the almost transparent shell remained. Not only do the plants acquire insectivorous habits, but I believe that each leaf modification is a special adaptation to promote the successful capture of food. The horseshoe-shaped leaves lie beneath the long grasses, and the spiral stems have learned to grow upwards amongst tufts of rushes, for one and the same purpose—viz., the increased facilities for alluring insects to destruction.

There are not so many birds to be seen in the mountains as might be expected, or, if present in the fastnesses of inaccessible gullies, they keep far beyond sight. An old Australian informed me that all the best of the bird life finds a habitat on the inland side of the great watershed; that is, the Regent, Bower, and Rifle birds, and all the more brilliant species, of which a magnificent collection is exhibited in the Sydney Museum. But, for all that, plenty remain for observation. The strange cry of the Laughing Jackass (*Dacelo gigas*) resounds on all sides; it thrives where no water is, living on snakes and the smaller reptiles. In passing, I may state that two of these amusing birds here in England have only been seen to drink about three times in the year; they feed chiefly on mice and raw meat, living out of doors except in severe weather, and laughing as if in their native bush. The melodious song of the Piping Crow—one of the few Australian songsters—I heard chiefly in the early morning. The sooty-grey bird with black wings and tail—both edged with white—hovering round the heads of the Eucalypti, is the Wood Swallow (*Artamus sordidus*). Amongst the numerous so-called "Robins" of New South Wales several kinds are met with in the Blue Mountains. The flame-breasted species, with a white patch on the forehead, white bars on the black wings, and a black tail, is a splendid bird. Another has a rose-coloured breast, while a third, seen deep down in the glen, has a sulphur-yellow breast. Shrikes and Flycatchers are common; "Wanga-Wanga" and Bronze Wing pigeons circle overhead. Creeping among the rocks I saw the Diamond Bird (*Pardalotus punctatus*), hardly bigger than a Wren. The black of the upper parts is relieved by numerous white spots on the head, and bolder spots at the edges of the wings and tail. The throat and breast are orange-yellow.

For several days not a Parrot was visible, until, after a sharp thunderstorm, a flock invaded the glen from the extensive bush beneath. Crimson Lories occupied the lower branches of the trees, apparently undisturbed by the approach of strangers. I could have knocked one over with a stick without difficulty. Gaudy Rosellas and Blue Mountain Parrots screeched at one another in discordant tones; with field-glasses every feather could be distinguished, the blue, green, red and yellow colours affording most startling contrasts. In a few hours all had departed to whence they came; the atmospheric disturbance had stirred them up to a temporary migration.

Few marsupials can be seen so near to the civilized haunts of mankind. Scrambling over distant crags, on the far side of the valley, I saw a single Rock Wallaby. Opossums hide in the tall trees, often present but generally unsuspected by those below.

The Echidna, an ant-eating pouched animal, described by Mr. Lydekker in the March number of KNOWLEDGE, is frequently to be seen half buried in the sand, with its quills standing above ground like a clump of withered grass. It is smaller than a Porcupine, but considerably larger than our English Hedgehog. The back is armed with black and white spines intermixed with coarse hairs.

The amphibious Duck-billed Platypus is a wary animal, inhabiting the neighbourhood of streams. At the approach of danger it dives from the land to its native home under the shelter of the shelving bank. The animals are few and far between. To obtain a rapid and comprehensive knowledge of the fauna, it is better to trust to the admirable collections in the Sydney Museum, or, if possible, to study the living marsupials in the pleasantly situated Zoological Gardens in Melbourne.

Notices of Books.

The Evolution of Sex. By Prof. PATRICK GEDDE and J. ARTHUR THOMSON. (London: Walter Scott, 1889.) This book introduces the reader in comparatively simple language, and with the aid of many excellent woodcuts, to the rich harvest of facts which has rewarded the labours of recent embryologists. Nearly all the burning questions of biology are touched upon—Hermaphroditism, Parthenogenesis, the Alternation of Generations, the speculative views of Professor Weismann, and the theories of Charles Darwin and Alfred Russell Wallace with regard to sexual selection, are all made use of to develop our authors' theory of the Evolution of Sex, and its bearing on the great questions of human population and progress. The simplest of all animals—the Amœba—reproduces

itself solely by budding, or by splitting itself into two portions, each of which forms a new individual. Hence, Weismann's view that the Protozoa (the lowest class of animals) are immortal—barring accidents or violence. Advancing one step higher to the Metazoa, one of its lowest members—Hydra—also increases in numbers by budding, and, as its name tells us, if cut in pieces, each piece becomes a new Hydra. Budding, or fission, then, is common in the lower animals, and exceedingly common in plants; Anacharis, the Canadian pond-weed, which is a *female* plant, has spread throughout the waterways of England solely by budding, and the bulbils on ferns and onions are other well-known instances. But there is also in the Hydra true sexual reproduction; female elements ova, or eggs, and male elements spermatozoa—the antherozoids of plants—are formed, and by their conjunction a new Hydra comes into existence: and these are the essentials of all *sexual* Reproduction in Animals and Plants. The egg-cell (in the star-fish, and probably all other animals), while maturing for fertilization, throws off two small portions of matter called Polar Bodies, which the late Professor Balfour regarded—like the expulsion of the canal-cells by the vegetable ovule—as a preventive against self-fertilization. Messrs. Geddes & Thomson say: "To this it must now be pointed out that, so far as one polar globule is concerned, extrusion does not prevent parthenogenesis" (*e.g.* development from an unfertilized egg-cell). With respect to this, we are content to quote Professor Vines' opinion: "A gamete (a sexual cell) is, as a rule, converted into a spore by means of the sexual process"; the loss of matter in the Polar Bodies "determines the sexuality of the reproductive cell; when the reduction does not take place" (or takes place only imperfectly?) "the product is not a gamete but a parthogenetic spore." And, again, on the defects of self-fertilization, which our authors seem to consider exaggerated, Professor Vines says: "By his extended observations on the relative efficiency of cross and self-fertilization, Darwin proves that the offspring of the union of . . . two distinct individuals have an immense advantage in height, weight, constitutional vigour, and fertility over the *self*-fertilized offspring of one of the same plants." And it is interesting that self-fertilization occurs particularly in several parasitic worms, and in parasitic plants, suggesting great degeneration. All through Nature, the male element, the antherozoid or spermatozoon, is more actively motile than the female egg-cell. So, too, in many ways the male individual is more abounding in energy than the female. The male generally sings among song-birds; in Birds and Butterflies the male generally rejoices in the more brilliant colouring; in fishes likewise (witness the male stickleback in the breeding season). It is noticeable, also, that the anthers of a flowering-plant are always brighter than the stigma or style, though this may be only part of the general colouring of flowers to attract insects. Darwin considered these manifestations of masculinity to be due to the selecting action of the females, *i.e.* those with the purest notes or brightest colours would be chosen as mates. No doubt Natural Selection comes in, but only so that the strongest males get their pick of the females. Mr. Wallace consequently argues that quiet colours of females are mostly protective in origin; "when both sexes (of birds) are brilliant or conspicuous, the nest is such as to conceal the sitting bird; but when the male is highly coloured and the female sits exposed on the nest, she is always less brilliant, and generally of quite sober and protective hues." Our authors believe that these male ornaments and eccentricities come from the superior dissipation of energy (katabolism) in the males as contrasted with the storage-up of energy (anabolism) in the females. Hermaphroditism—that is male and female organs of Reproduction in the same individual, as in snails—seems to have been an early condition of Sexual Reproduction. But in these animals and plants the alternating periods of activity (usually the male commencing) show the tendency to separation of the sexes, and even in the highest animals traces can be seen of similar parts which have (through disuse?) dwindled into insignificance or taken on other functions. Almost the most interesting part of the present volume treats of the determination of sex. Ladies will be pleased to hear that among the lower animals at least males are produced from underfed mothers or their young. As Burns puts it, Nature "Tried her 'prentice han' on man, And then she made the lasses, oh!" This is especially noticeable in connection with statistics, which show that after an epidemic or a war the male births are in a greater majority than usual, and the fact stated by Düsing that there is always produced a majority of the sex that is wanted.

Glimpses of Animal Life: A Naturalist's Observations on the Habits and Intelligence of Animals. By William Jones, F.S.A. (Elliot Stock, London.) Would make an excellent gift-book for young people. It is full of stories about animals, well told and well selected. The chapter on the Playfulness of Animals is one of the best. It contains many original stories and observations likely to stimulate a boy to observe for himself, which is a species of mental training that cannot be commenced too early.

A Winter on the Nile, in Egypt, and in Nubia. By the Rev. Canon Bell, D.D. Second Edition. (Hodder and Stoughton.) The increasing popularity of Egypt as a health resort for over-worked professional men seems to have been fully justified in Canon Bell's experience; indeed, so great is the enterprise shown by the author while traversing the whole of the Nile valley as far as Wady Halfa, that it is difficult to realise that we have here the record of a tour undertaken by physician's advice with the view of recruiting health. The Canon's verdict is that while the climatic changes are too sudden, and the provision for creature comforts as yet too incomplete, to suit those who are seriously ill, yet no place could be more delightful for those who merely need rest and change of scene, or who wish simply to avoid the rigours of an English winter. An appendix, from the pen of Dr. T. D. Savill, gives an interesting series of observations on the climate of the Nile valley, the general conclusions being that as regards the amount of sunshine, the smallness of the rainfall, the dryness of the atmosphere, and the bracing character of the air, Egypt may deservedly take a high position in the catalogue of winter resorts for Europeans.

As the tour here described was undertaken so recently as the spring of 1888, and we have already the second edition of the book, it is needless to say that Canon Bell has told the tale of his wanderings acceptably. His sympathies are wide; he is not merely an antiquary on the tramp, nor does he permit even the architectural remains of the times of the Pharaohs and the Ptolemies, marvellous though they are, to absorb the whole of his attention, but is ever ready to notice features of interest in the life of the present as well as to revel in the glories of the dead past; hence we have Egypt presented to us as it actually is to-day—a strange mixture of the antique and the modern, the awe-inspiring and the grotesque, the grand and the commonplace. Temples, tombs, and colossi, in all the majesty of a hoary antiquity, divide the traveller's attention with audacious and irrepressible donkey-boys,

coarse-featured dancing girls, and the everlasting "backsheesh." The Canon has the happy faculty of making himself at home with everybody, and thus manages to study human nature under the most varied conditions, and the sketches he gives of his experiences of both high and low life are full of interest, and often highly amusing. At one time we find him and his party taking coffee under the shade of a tree outside the mud hut of a fellah of the Theban plain, in the company of his host's pair of wives as well as that of sundry specimens of his cattle; at another he appears doing penance in the form of a dinner at a Coptic wedding feast at Cairo.

All the chief places of interest, from the Pyramids up to Aboo Simbel, are visited in succession, and the antiquities of each are described in a style which is sympathetic, concise, and clear, and which, while not overcharged with detail, yet gives a vivid conception of the treasures which still remain where they have stood, some of them for thousands of years, to attest the former mightiness of the monarchs by whom they were erected. By not merely giving his own impressions, but by also availing himself largely of the most recent authorities in Egyptology, the author has made a reliable descriptive guide-book to the antiquities of Egypt; and to those who cannot visit the country itself, it may be commended as an excellent book of travel, while to those who are permitted to see for themselves the sights that have been the wonder of the world since the time of the Father of History, it will serve as an admirable companion and guide.

The Origin of Civilisation and the Primitive Condition of Man. (*Mental and Social Condition of Savages.*) By Sir JOHN LUBBOCK, Bart., M.P., F.R.S. Fifth Edition, with numerous additions. (London: Longmans & Co., 1889.) A book that marks "fifth edition" on its title-page has no slight passed upon it if its re-issue is noted without comment. But public interest in anthropology, especially as bearing on the growth of society and its manifold institutions, increases apace, and the author of a recognised standard work upon the subject must revise his materials from time to time and embody the new matter which pours in so abundantly and quickly as to prevent the latest editions of his book from being up to date. This applies especially to the work before us, the special feature of which is its presentment of matter for the formation of judgments rather than of elaborate judgments themselves. Comparing it with earlier issues, we note considerable alterations and shifting of material, to which a good deal has been added, treating of marriage and relationship. In some directions the revision is not so complete as we had expected, many important books of travel, from which valuable matter might have been taken, being overlooked. The omission of reference to cannibalism, respecting which Mr. Romilly's *Western Pacific* has so enlarged our knowledge, is a defect in a work treating of savage morals; the remarks on dreams, which play no mean part in the lower psychology, would bear expansion, and the section on Totemism does not make clear the common base on which it is held to rest, namely, belief in animal or plant descent. But perhaps Sir John Lubbock is not satisfied as to the soundness of that view of it, and in all doubtful questions his book admirably reflects the cautious attitude of true science. We notice looseness here and there in the citations of authorities, *e.g.* the learned Bishop Callaway is described as "Dean," "Mr.," and "Canon," at pp. 221, 239, and 244 respectively.

The Scenery of the Heavens. By J. E. GORE, F.R.A.S. (London: Roper & Drowley, 1889.) This is a popular account of the wonders of astronomy, something in the style of the author's earlier *Planetary and Stellar Studies*; but the various essays are arranged in their proper order, commencing with the sun, passing by the moon, inferior and superior planets, comets, shooting stars, &c., on to the stars, double and binary, temporary and variable; the nebulæ, clusters, and the milky way. The final chapter on the "Astronomy of the Poets," by which Mr. Gore means certain English poets, is curious as a collection of extracts. But it is rather interesting from a literary than from an astronomical point of view. The best chapter in the book is that on variable and temporary stars, which is Mr. Gore's strong subject.

The other chapters have been carefully prepared, the figures contained in the volume having been computed with a solar parallax of 8″·80. Probably the book was printed too early to include any account of Schiaparelli's researches on Mercury, but we do not understand why Glasenapp's results in his *Orbites des Etoiles Doubles du Catalogue de Poulkova* are left unnoticed in the chapter on "Binary Stars." The parallax of Sirius is probably somewhere about 0″·40, and this, with Mr. Gore's orbit, gives a mass of $2\frac{9}{10}$ the sun's mass, which seems to be nearer the truth than that given by Mr. Gore, viz. $26\frac{1}{4}$ times that of the sun, as obtained by using Gyldén's parallax of 0″·193 (which he computed from very inferior results) and his own orbit; or $33\frac{1}{3}$ times the solar mass, using the same parallax and Colbert's orbit. There seem to be very few misprints; one we notice on page 102 of 1787 for 1781, while the comet of 1680 was first detected by G. Kirch, and not by Halley. The volume is well got up, and contains numerous illustrations, many of them being small glass prints from photographs by M. M. Henry and Mr. Roberts. The work reflects credit on Mr. Gore.—H. S.

Astronomy with an Opera-Glass. By GARRETT P. SERVISS. (D. Appleton & Co., New York, 1889.) The greater part of the articles in this work appeared in the *Popular Science Monthly*, and, owing to the favourable reception they met with there, the author has been encouraged to reprint them in book form. Nothing, it is stated, is given in the book which the author has not seen himself with an opera-glass or a field-glass. The illustrations seem to have been drawn with some care, though it would require a very large telescope to show some of the stars in the diagram of the Pleiades (as seen with a field-glass) on page 103, and some mention might have been made, on page 105, of the later photographs of the nebulæ in this cluster by Mr. Roberts. κ^1 and κ^2 Tauri *have* been seen separated with the naked eye by Heis and others, though Mr. Serviss seems to think the feat an impossible one. The work can be obtained in London of Messrs. Allen & Co., Caxton House, Paternoster Square.—H. S.

Letters.

[The Editor does not hold himself responsible for the opinions or statements of correspondents.]

To the Editor of KNOWLEDGE.

DEAR SIR,—G.C.G.'s letter "A Grub in a Bottle of Wine," March 1st, reminds me of a somewhat similar experience which occurred to me some years ago.

I was helping the curator of one of the London schools, and came across a large leaden tank covered with a heavy lid of the same metal. It had evidently not been opened for some years, as the edges all round were encrusted thickly

with dirt, so that I had to clean and cut it away before I could raise the lid.

On doing this, the instant air entered, a cloud of hundreds of small flies rose from it and vanished.

I should tell you that the tank contained pickled anatomical specimens which had been originally saturated with methylated spirits of wine.

Yours faithfully,
Frank Atkinson.

[The case seems hardly parallel to that of G.C.G. Our correspondent does not say definitely whether the spirit had, at the time of opening the tank, entirely evaporated, although the use of the word *originally* seems to imply that such was the case. If so, the tank was probably open to the air by some minute aperture sufficiently large to permit either of the entry of the original founders of the fly colony, or the insertion of their eggs. The larvæ from these would feed on the dried "anatomical specimens," and might pass through their cycle of changes and breed and multiply, generation after generation, as long as sufficient food remained. During an exhumation in a cemetery at Ivry a few years ago, great numbers of a species of fly (*Phora aterrima*) were discovered in coffins which contained corpses that had been buried for two years at a depth of upwards of six feet.—E. A. Butler.]

To the Editor of Knowledge.

FLYING DRAGONS.

Sir,—Mr. Lydekker, writing on "Flying Dragons" last month, says that the elongated finger of the Pterodactyles "corresponds to the little finger of the human hand." That was the view of Goldfüs (fifty years ago); but one expects some reference to the determinations arrived at by Prof. H. G. Seeley, which gave to these Ornithosauria a radial, not ulnar, source of the bones carrying the membrane of flight. Following Prof. Seeley, I examined a large number of these fossils, and could only conclude that the structure of the *manus* was on the avian plan, the "finger" corresponding to the radial index of birds, which carries the great flight feathers. Mr. L. does not even mention Prof. Seeley's work in this direction, which has been accepted as classical, but tells us that "on the whole it is probable" that the manus had no avian structure. I would, then, ask him to refer me to the fossils which enable him to thus dispose of Prof. Seeley's conclusion that the attachment of the "finger" was radial. Evolutionists will understand the importance of this.

Seeley places these forms in the direct line of avian development.

Yours truly,
Watford, April 10, 1890. Arthur Nicols.

[The theory of the homology of the bones of the hand of the Pterodactyles, alluded to by your correspondent, having fallen into oblivion, I have not thought it necessary, in the article in question, to make any reference to it, and have therefore followed the universally accepted and true explanation. Your correspondent wishes to be informed how this explanation is arrived at. If he will look at the figure on page 109, and recollect that the animal is lying on its back with the palmar surface of the hand exposed, it is perfectly evident that the little short splint seen at the wrist will represent the radial, and the elongated finger the ulnar side. Your correspondent quotes me as saying that this elongated finger "corresponds to the little finger of the human hand"; what I really said being, "It is on the whole probable that this elongated finger corresponds to the little finger of the human hand, the thumb being probably represented by the small splint-like bone seen at the wrist in Fig. 1 [p. 109], and in any case the finger in question is the outermost one, whether it correspond to the ring-finger or the little finger of the human hand." The question whether the elongated finger of the Pterodactyle really corresponds to the ring or the little finger depends on the view taken as to the equivalence of the splint on the radial side of the wrist. Prof. Huxley (*Anatomy of Vertebrated Animals*, 1st ed., p. 269, 1871) took the view that this splint did not represent the metacarpal of the thumb, and accordingly considered the elongated digit as the fourth or ring-finger. Subsequently, however, Prof. O. C. Marsh (*American Journal of Science*, vol. xxiii. p. 255, 1882) came to the conclusion that the radial splint really represents the thumb, when the elongated digit will be the fifth, or "little" finger. If your correspondent is desirous of further information on this subject, he may advantageously consult the paper by Prof. Marsh to which I have referred.

In regard to the alleged ancestral relationship of Pterodactyles to birds, it will perhaps suffice if I quote a sentence from Professor Alfred Newton's article "Ornithology" in the 9th edition of the *Encyclopædia Britannica*. Speaking of *Archæopteryx* (a fossil bird), Professor Newton observes "it throws, for instance, the Pterodactyles—so often imagined to be nearly related to Birds, if not to be their direct ancestors—completely out of the line of descent."—R. Lydekker.]

To the Editor of Knowledge.

Dear Sir,—With reference to the peculiar substance named Tabasheer, which occurs now and then on the floor inside the jointed bamboo stems (Knowledge, April, p. 113), may I draw your attention to a similar opaque body that is found inside the coco-nut, and known as the "coco-nut pearl"? I think it is described in Hickson's recent book on the Celebes Islands as having a basis of lime.

Yours truly,
C. Parkinson.

[Many other substances are occasionally deposited within the living tissues of plants and animals—as well as in cavities surrounded by living tissue. Everyone is familiar with the small hard masses often found in pears, which consist of groups of needle-like crystals of carbonate of lime, known as Raphides. In animal tissues, besides the many kinds of calculi which form in cavities, there are pearls; and chalk stones (really urate of soda) in the swollen fingers of gouty people. In the gouty feet of parrots a crystalline nitrogenous body called guanin (because it was first discovered in Peruvian guano) is found in tufts of feathery crystals.—A. C. R.]

SOUND OF THE AURORA.

To the Editor of Knowledge.

Sir,—I am in the singular position of being the only person I know of who has heard the sound of the Aurora.

I communicated my experience in a letter to *Nature* fully nine years ago. I think it was during the winter of 1866—when there was a magnificent Aurora pulsing across the zenith, with bright white light—that my father (since dead) and I listened to the sound with great wonder. It was like the rustling or switching of silk, and rose and fell

with the brightness more or less of the light. It caused us some discussion, and we felt all the surer of our experience when we found written in Burns's fragment, entitled "A Vision,"

> "The cauld blae north was streaming forth
> Her lights, wi' hissing eerie din;
> Athort the lift they start and shift,
> Like fortune's favours, tint as won."

Tacitus, in "Germania," 45, alludes to the sound of the Aurora. Fanny Kemble, in her *Record of a Girlhood*, vol. i., describes a splendid Aurora which she observed from a balcony in Edinburgh, which had a crackling sound like the flickering of blazing fire, the light being white.

A gentleman, writing under initials in the New York *Weekly Evening Post*, referred to the communications in *Nature*, and stated that in 1846, crossing the Atlantic from Newfoundland to Greenock in the brig *Amanda*, near the Southern Hebrides, they listened for four hours one night, while a most magnificent white aurora was overhead, to "a sound, as if the folds of heavy silk were shaken, sometimes sharp and quick, and then receding until the sound was lost, according to the intensity of the flash."

Whether any more evidence has been collected, during the last nine years, of this rare experience, I do not know.

Yours faithfully,

Tynron, Dumfriesshire, 8th April. J. Shaw.

THE FACE OF THE SKY FOR MAY.

By Herbert Sadler, F.R.A.S.

THERE have been one or two fair-sized solar spots during the past month, but at the time of writing these lines the solar disc is absolutely free from any markings. Minima of δ Libræ (*cf.* "Face of the Sky" for April 1889) occur at 1h. 0m. A.M. on the 12th, and 0h. 9m. A.M. on the 25th. A maximum of χ Cygni (*cf.* "Face of the Sky" for April 1889) may be expected on the 30th. Mercury is excellently placed for observation during the first half of the month, as he sets on the 1st at 9h. 29m. P.M. (2h. 9m. after sunset) with an apparent diameter of 7″·0, and a northern declination of 22° 52′. On the 14th he sets at 9h. 35m. P.M. (1h. 55m. after sunset) with an apparent diameter of 10″, and a northern declination of 24° 5′. After this he rapidly approaches the sun, coming into inferior conjunction on the 30th of the month. During its period of visibility the planet is in Taurus, being at its greatest eastern elongation (21°) on the 6th, and apparently stationary on the 18th; but he does not approach any naked-eye star very closely. During the first fortnight in May Mercury, Venus, and Aldebaran will form a very pretty triangle near the W.N.W. horizon in the evening twilight. Venus, like Mercury, is an evening star, setting on the 1st at 9h. 4m. P.M., with an apparent diameter of 10½″, and a northern declination of 20¼°. On the last day of the month she sets at 10h. 15m. P.M. with an apparent diameter of 11⅓″, and a northern declination of 24¾°. At 7h. A.M. on the 10th she is in conjunction with Mercury, the latter planet being 1¾° north. Her disc now appears markedly gibbous. During the month Venus passes through Taurus into Gemini. On the evening of the 6th she is near κ Tauri; at 8h. 30m. P.M. on the 10th she is about 4¼′ south of and a little *p.* the 4½ magnitude star τ Tauri, the star and planet forming a very close and pretty double star to the naked eye. Venus does not approach any other prominent naked-eye star during May. Mars, if it were not for his extreme southern declination, would be very favourably situated for observation during May, but with an altitude of only 14° or 15° on the meridian only a few features of the markings on his surface will be visible to observers in these latitudes. Mars rises on the 1st at 10h. 7m. P.M. with an apparent diameter of 16″·0, and a southern declination of 22° 41′. On the 31st he rises at 7h. 37m. P.M., with an apparent diameter of 19¼″, and a southern declination of 23° 3′. He is in opposition on the 27th, his distance from the earth being then about 45¾ millions of miles. He describes a retrograde path through portions of Ophiuchus and Scorpio, and at midnight on the 25th will be about 9′ *n.f.* the very pretty double star ρ Ophiuchi. Pallas is still visible, and passes the meridian on the 23rd at 10h. 58m. with a northern declination of 26° 11′. During the month she passes from Corona Borealis into Boötes. At transit on the night of the 8th she will be 14′ due south of a 6th magnitude star in Corona; but she does not approach any other naked-eye star very closely. Ceres is in opposition to the sun on the 17th, when she is at a distance of about 161¾ millions of miles from the earth, and appears as a star of 7·6 magnitude. During the month she describes a retrograde path in Libra, but without approaching any naked-eye star. Her diameter is given, from photometrical considerations, by Argelander at 226 miles, and by Stone at 196 miles. From direct measures of the disc Galle found 400 miles, Knott 631 miles, and Schröter the extravagant value of 1,570 miles. The planet appears of a ruddy yellow colour. On the 23rd she souths at 11h. 33m. P.M. with a southern declination of 12° 48′. Juno is in opposition to the sun on the 26th, when she is at a distance of about 219 millions of miles from the earth, and appears as a reddish star of 10·0 magnitude, the opposition not being a favourable one. At a very favourable opposition she may appear as bright as a 7 magnitude star. Her diameter is given, from photometrical considerations by Argelander at 106 miles, Pickering 94 miles, and Stone 124 miles. Schröter raised the diameter with his imperfect micrometrical means to 1,380 miles. On the 31st she souths at 11h. 40m. P.M. with a southern declination of 3° 16′. She describes a retrograde path in Ophiuchus throughout May in a region barren of naked-eye stars. Jupiter is a morning star, rising on the 1st at 1h. 49m. A.M. with a southern declination of 17° 57′ and an apparent equatorial diameter of 39″. On the 31st he rises at 11h. 51m. P.M. with a southern declination of 17° 42′, and an apparent equatorial diameter of 43″. The following phenomena of the satellites occur while the planet is more than 8° above and the sun 8° below the horizon. An occultation disappearance of the third satellite at 2h. 38m. A.M. on the 8th, and an eclipse disappearance of the second satellite at 3h. 9·0m. the same morning. An eclipse disappearance of the first satellite at 3h. 10m. 51s. A.M. on the 9th. A transit egress of the shadow of the first satellite at 2h. 45m. A.M. on the 10th and a transit egress of the second satellite at 3h. 4m. the same morning. An eclipse disappearance of the fourth satellite at 2h. 49m. 19s. A.M. on the 11th.

A transit ingress of the shadow of the first satellite at 2h. 19m. A.M. on the 17th, a transit ingress of the second satellite at 2h 43m. A.M. the same morning, and a transit egress of its shadow nineteen minutes later. A transit ingress of the shadow of the second satellite at 2h. 47m. A.M. on the 24th. An eclipse disappearance of the first satellite at 1h. 27m. 12s. A.M. on the 25th. A transit egress of the first satellite at 2h. 15m. A.M. on the 26th, and a reappearance from occultation of the second satellite at 2h. 51m. A.M. the same morning. An eclipse reappearance

of the fourth satellite at 1h. 13m. 33s. A.M. on the 31st. Jupiter describes a short path in Capricornus, and is stationary on the morning of the 31st, being then about 10′ *s.p.* the 4th magnitude star θ Capricorni. On the nights of the 21st to 24th a 7th magnitude star will be about 6′ north of the planet. Saturn is an evening star, and is now rapidly approaching the west. On the 1st he rises at 0h. 3m. P.M. and sets at 2h. 42m. A.M., having a northern declination of 14° 5′ and an apparent equatorial diameter of $18\frac{1}{4}''$ (the major axis of the ring system being 42″ in diameter, and the minor $8\frac{1}{4}''$). On the 31st he souths at 5h. 26m. P.M., and sets at 0h. 45m. A.M., having a northern declination of 13° 43′, and an apparent equatorial diameter of $17\frac{1}{4}''$ (the major axis of the ring system being $39\frac{3}{4}''$ in diameter, and the minor $7\frac{1}{2}''$). At 8h. 45m. P.M. on the night of the 9th there will possibly be an eclipse of Dione. At 10 P.M. on the 19th Iapetus will be in conjunction with the following end of the ring at 4″ to the south of it. At 8h. 30m. P.M. on the 20th there will be an egress of Iapetus from transit over the ring; and a little later the satellite will be in conjunction with the preceding end of the ring, 2″ to the north. At 6h. 30m. P.M. on the 31st there will possibly be an eclipse of Dione. Saturn is in quadrature with the sun on the 18th. He describes a very short path in Leo above Regulus through a region barren of naked-eye stars. Uranus is favourably situated for observation, rising on the 1st at 5h. 31m. P.M. with a southern declination of $8\frac{3}{4}°$, and an apparent diameter of 3″·8. On the 31st he rises at 3h. 27m. P.M. with a southern declination of 8° 23′, and an apparent diameter of 3″·7. He describes a short path to the north of 76 Virginis during the month. Neptune is in conjunction with the sun on the 25th. There are no well-marked showers of shooting stars in May. The moon is full at 9h. 9m. P.M. on the 4th; enters her last quarter at 4h. 22m. P.M. on the 11th; is new at 8h. 19m. P.M. on the 18th; and enters her last quarter at 10h. 34m. P.M. on the 26th. At 1h. 18m. A.M. on the 3rd the 6th magnitude star 65 Virginis will disappear at an angle of 28° from the lunar vertex, and reappear at 1h. 54m. A.M. at an angle of 330°. At 8h. 4m. P.M. on the 3rd the 7th magnitude star 94 Virginis will disappear at an angle of 56° from the vertex, and reappear at an angle of 191° at 9h. 5m. P.M., while at 8h. 50m. P.M., the same evening, the 6th magnitude star 95 Virginis will disappear at an angle of 350° from the vertex, and reappear at 9h. 40m. P.M. at an angle of 267°. At 1h. 8m. A.M. on the 4th the $4\frac{1}{2}$ magnitude star κ Virginis will disappear at an angle of 14° from the vertex, and reappear half an hour later at an angle of 229° from the vertex. At 2h. 35m. A.M. the 3rd magnitude star β^1 Scorpii will disappear at an angle of 82° from the vertex, followed almost instantly by the disappearance of its companion β^2 Scorpii (a lilac-coloured $5\frac{1}{2}$ magnitude star at 13″·7 distance from the large star on an angle of $25\frac{1}{2}°$). The disappearance of β^1 Scorpii itself should be carefully watched, as it is a close and unequal pair, the distance being under 1′. About a quarter of an hour after the disappearance of β^1 and β^2 Scorpii a 7th magnitude star will be occulted about 30° to the north of where β^1 and β^2 disappeared. β^1 Scorpii reappears at 3h. 48m. A.M. at an angle of 281°, and is immediately followed by its companion. At 4h. 42m. A.M. on the 7th the 5th magnitude star ψ Sagittarii disappears at an angle of 85° from the vertex, the sun having risen 23 minutes at the time, and reappears at 5h. 53m. A.M. in bright sunlight at an angle of 310° from the vertex. At 3h. 38m. A.M. on the 11th the $5\frac{1}{2}$ magnitude star ϕ Capricorni makes a near approach to the lunar limb at an angle of 172° from the vertex. At 9h. 17m. P.M. on the 28th the 7th magnitude star B.A.C. 4104 will make a near approach at an angle of 167° from the vertex. At 2h. 10m. A.M. on the 31st the $6\frac{1}{2}$ magnitude star B.A.C. 4647 will disappear at an angle of 118° from the vertex, and reappear at 3h. 7m. A.M. at an angle of 273° from the vertex, the moon having set at Greenwich at the time.

Whist Column.

By W. Montagu Gattie.

THE ADVANTAGE OF THE DEAL.

We are indebted to Mr. F. S. Hughes for the following interesting calculations, from which it clearly appears that players who through inattention miss their turn to deal lose more than is generally supposed.

Distribution of Trumps.

The probable number of trumps for the dealer $= 1 + 12 \times \frac{12}{51} = 3\frac{14}{17}$. The probable number for each of the other players $= 3\frac{1}{17}$.

Distribution of Honours.

The Dealer.

Case I.—To find the probability that *exactly* one honour (*i.e.* one honour and no more) will fall to the dealer.

(i.) Honour not turned up—probability $= \frac{9}{13}$. Out of the remaining 51 cards, of which 4 are honours, he is to receive 1 honour and 11 other cards.

There are $\frac{\lfloor 47}{\lfloor 36 \lfloor 11}$ ways in which combinations of 11 cards can be obtained out of 47, and each of these can be combined with an honour in 4 ways. Hence, the probability of *exactly* one honour on hypothesis (i.) is

$$\frac{4 \lfloor 47}{\lfloor 36 \lfloor 11} \div \frac{\lfloor 51}{\lfloor 39 \lfloor 12} = \frac{4 \times 39 \times 38 \times 37 \times 12}{51 \times 50 \times 49 \times 48} = \frac{39 \times 38 \times 37}{51 \times 50 \times 49}$$

(ii.) If honour turned up (probability $\frac{4}{13}$), the probability of *exactly* one honour is

$$\frac{\lfloor 48}{\lfloor 35 \lfloor 12} \div \frac{\lfloor 51}{\lfloor 39 \lfloor 12} = \frac{39 \times 38 \times 37}{51 \times 50 \times 49}$$

In other words, the probability that a dealer who has turned up an honour does not hold another is precisely equal to the probability that, when he has *not* turned up an honour, he will find just one honour among his twelve other cards.

It follows that the probability of *exactly* one honour is in any case

$$\frac{39 \times 38 \times 37}{51 \times 50 \times 49} = \cdot 43884$$

Case II.—The probability of *exactly* two honours can similarly be shown to be—

$$\frac{4}{13} \times \frac{3 \lfloor 48}{\lfloor 37 \lfloor 11} \div \frac{\lfloor 51}{\lfloor 39 \lfloor 12} + \frac{9}{13} \times \frac{6 \lfloor 47}{\lfloor 37 \lfloor 10} \div \frac{\lfloor 51}{\lfloor 39 \lfloor 12} = \frac{39 \times 38 \times 12}{13 \times 51 \times 50 \times 49} \times \left(12 + \frac{99}{8}\right) = \cdot 26686$$

Case III.—The probability of *exactly* three honours is

$$\frac{4}{13} \times \frac{3 \lfloor 48}{\lfloor 38 \lfloor 10} \div \frac{\lfloor 51}{\lfloor 39 \lfloor 12} + \frac{9}{13} \times \frac{4 \lfloor 47}{\lfloor 38 \lfloor 9} \div \frac{\lfloor 51}{\lfloor 39 \lfloor 12} = \frac{39 \times 11 \times (144 + 90)}{13 \times 51 \times 50 \times 49} = \cdot 06180$$

Case IV.—The probability of four honours is

$$\frac{4}{13}\times\frac{\binom{39}{9}\binom{9}{}}{\binom{51}{12}}+\frac{9}{13}\times\frac{\binom{39}{8}\binom{8}{}}{\binom{51}{12}}=\frac{12\times11\times10}{13\times51\times50\times49}\times\left(4+\frac{81}{48}\right)=\cdot00462$$

Case V.—The probability of no honour is

$$\frac{9}{13}\times\frac{\binom{35}{12}\binom{12}{}}{\binom{51}{12}}=\cdot22786$$

Non-Dealer.

Case I.—Probability of *exactly* one honour=·43884.
Case II.—Probability of *exactly* two honours=·19570.
Case III.—Probability of *exactly* three honours=·03433.
Case IV.—Probability of four honours=·00198.
Case V.—Probability of no honour=·32913.

By similar processes it may be ascertained that—

(1) The probability that the dealer and his partner will, between them, hold all four honours is ·0690.
(2) The probability that the dealer and his partner will hold *exactly* three honours is ·2809.
(3) The probability that the side opposed to the dealer will hold all four honours is ·0414.
(4) The probability that the side opposed to the dealer will hold *exactly* three honours is ·2185.
(5) The probability that honours will be divided is ·3902.

Many curious results may be immediately deduced from these calculations, *e.g.*—

The probability of holding *exactly* one honour is the same for all four players.

The dealer should expect to be without an honour not quite so often, on the average, as once in every four deals.

When not dealer, a player should expect to be without an honour about once in every three deals.

The dealer may expect to hold two honours or more once in every three deals.

When not dealer, a player should not expect to hold two honours or more so often as once in four deals.

The dealer may expect to hold three or four honours in his own hand about once in fifteen deals.

When not dealer, a player should not expect to hold three or four honours quite so often as once in twenty-seven deals.

The dealer will probably hold all four honours from four to five times in a thousand deals.

When not dealer, a player may expect to hold all four honours scarcely twice in a thousand deals.

The dealer's side may be expected to hold three or four honours thirty-five times in a hundred.

The non-dealing side may be expected to hold three or four honours twenty-six times in a hundred.

Honours may be expected to be divided thirty-nine times in a hundred.

A NEW DEPARTURE.

To the Editor of KNOWLEDGE.

SIR,—While our leading authority is flatly contradicting himself in his own newspaper and flying in the face of his own book, and the general public is under the lamentable delusion that it has got to the root of the matter by discarding the suit it wants led, the forced discard to an adverse trump lead is in parlous case; but there is one point—first suggested by the late Mr. Proctor—which, as tending to mitigate one of its difficulties, is worth more attention than it has hitherto received; that point is, "when unable to follow suit in trumps, if you are discarding from a really strong suit (not mere length, an entirely different thing), 'Peter' in that suit." The idea, of course, is based on the old discard from the head of a very strong suit, and it has these advantages; there is no hard and fast line; it shows absolute strength; it allows you to use your own judgment—to declare the signal at once, to conceal it for a time, or to suppress it altogether if you think fit; it is also often useful even when your partner is the trump leader. Minor details, such as that, when you have only one discard, a high card is probably a signal, while a very small one is certainly not, if not obvious at a glance, are best left to the professional development-monger. I have been told it is "bad play," but I have heard that unsupported assertion so often that it has lost all terror for me.

With innumerable treatises; treatises on developments, on counting number, on exceptional play; treatises philosophical, and treatises arithmetical; with arrangements for exorcising superfluous winning cards as elaborate as if winning cards were enemies of the human race and a direct emanation from the evil one; with school-boy exercises in simple addition; with a treatise on perception, culminating in an illustrative hand, where the original leader, himself one of the *illuminati*, holding ace, king, queen of spades, ace, king, queen, knave of clubs, queen of diamonds, and queen, knave, ten, six, and three of hearts (trumps), contrived to lose five by cards, it is time, if possible, to import a little common sense into the game, and to make some slight effort to win an occasional trick.

I am, Sir, yours, &c.,

PEMBRIDGE.

[We have always abstained from pinning our faith to any particular cult of whist philosophy, and are ready to welcome suggestions, from whatever source they may come, which tend, in our judgment, to advance the theory of the game without detracting from its strategic possibilities. But we confess to some surprise at finding one of the most distinguished opponents of the "modern school" sallying into the field with an artifice which, as a specimen of preconcerted signalling, throws into the shade every convention that has been devised since the institution of our old friend "Blue Peter"; so much so that we are almost tempted to wonder whether this can be the first move in a deep-laid scheme for "dishing" the "development-mongers." On scientific grounds we see no objection to the innovation, which, as our correspondent observes, may be regarded as an extension of the existing practice of discarding the highest of a suit of which the player has absolute command; although we venture to think that the trick to be gained by its adoption would be very "occasional," since it is seldom desirable to discard more than once from a strong suit unless there is no chance of bringing it in at all. Perhaps the most likely case is that in which it is necessary to keep guarded a card or cards of re-entry, and in such contingency what may be called a "plain-suit call" might sometimes save a partner, who understood it, from a blunder. On the other hand, it must be remembered that a player not fully alive to this exceptional device might very well interpret the discard of a high card as a sign of weakness instead of strength; and, if similar tactics are to be employed in the presence of a friendly trump lead, and our partner of the future should so deal with us before the position of the remaining trumps is unmistakably declared, we trust that he will not be very angry at our mistaking his plain-suit call for an ordinary trump echo.]

XUM

Chess Column.

By I. Gunsberg (Mephisto).

[Contributions of general interest to chess-players are invited. Mr. Gunsberg will be pleased to give his opinion on any matter submitted for his decision.]

TOURNAMENT GAMES.

That there is a difference between tournament play and match play has often been established by individual contests between two players, which have entirely reversed the position of the same players in a tournament. It is on record that A came out a way down on the list in a tournament, whereas B's score was only second to that of the first prize-winner; and yet in a match subsequently played A reversed the positions by winning hands down. Many have been the curious results which have arisen in small tournaments, as in such contests luck has no time to right itself, as it mostly does in longer tournaments, and the result may be very one-sided indeed. In a tournament played not long ago, A and B were competing. A had beaten B, in a match, at the rate of 5 to 1, and out of over 20 games played in tournament and match play B had won but the one game alluded to above. In spite of the very great superiority—almost equal to pawn and move—which A had shown over B, by winning 20 to 1 against him, B came out in a small tournament with a better score than A. There is, however, another element to be taken into consideration besides luck, and that is the character of the play in a tournament. A successful tournament game has, in most instances, distinctive features, which constitute and emphasize the difference between tournament and match play. Many players, particularly when they are not playing for a high prize, and have not much to lose, are not afraid to launch out on original lines in the opening, and enter upon attacking variations instinctively, without troubling about soundness. They are not afraid to risk a pawn or so, and throw the burden of finding the right reply on their opponent, which is not always to be done, and causes a great many games to be won which, with the calmer treatment of match-play, would have been scored by the opponent. Further, we must not forget that there is such a thing as accidental positions, which were never foreseen by the attack, and operate more often to the disadvantage of the defence. Some experienced players allege that some of the best positions in tournament games were brought about in this accidental manner. However unreliable such play may be as an exact test of strength, it is certainly very pleasing, and nothing is more gratifying than to see a real successful tournament game. The game we publish below, between Messrs. Loman and Van Vliet, combines most of the features mentioned above, and is an admirable specimen of a successful tournament game.

Game played April 14 in Simpson's Handicap Tournament.

French Defence.

	White. Loman.	Black. Van Vleit.		White. Loman.	Black. Van Vleit.
1.	P to K4	P to K3	21.	Kt to B4	K to Kt sq
2.	P to Q4	P to Q4	22.	Kt to Kt6 (*j*)	P × Kt
3.	Kt to QB3	Kt to KB3	23.	B × B	R × Kt (*k*)
4.	P to K5 (*a*)	Kt to Q2	24.	R × R	Q × B
5.	P to B4	P to QB4	25.	Q to Q4	P to B4 (*l*)
6.	P × P	Kt to QB3	26.	Q to B3	R to Q2
7	P to QR3	Kt × BP (*b*)	27.	QR to Bsq	R to Qsq
8.	B to Kt5 (*c*)	P to QR3	28	P to QKt3	Kt to Kt3
9.	B × Kt (ch)	P × B	29.	R to B7	Q to Kt4 (*m*)
10.	Kt to B3	Q to Kt3	30.	Q × P	Kt to Q2
11.	Q to Q4	Q to B2 (*d*)	31.	Q to B7	K to R2
12.	Castles	Kt to Q2	32.	P to Kt3	P to Q5
13.	K to R1	QR to Kt1 (*e*)	33.	K to Kt2	R to Rsq (*n*)
14.	Q to B2	B to K2	34.	QR to B4	Q × KP
15.	Q to Kt3	Castles	35.	R to R4 (ch)	(*o*) K to Kt sq
16.	P to B5 (*f*)	K to Rsq (*g*)	36.	Q × B (ch)!	K × R
17.	P × P	P × P	37.	Q × Kt (ch)	K to B3
18.	B to Kt5 (*h*)	Kt to Kt3	38.	R to B4 (ch)	K to Kt4
19.	Q to R4!	R to Kt2	39.	Q to K7 (ch)	Q to B3
20.	Kt to K2	Kt to B5 (*i*)	40.	R × Q	Resigns

NOTES.

(*a*) I prefer 4 B to KKt5, for unless White succeeds in developing a speedy and successful attack—which is only occasionally possible if Black castles KR—then the exposed position of the White Pawn will cause inconvenience, and weaken White's game.

(*b*) In a game, Lipschütz-Delmar (Black) played here P to QR4.

(*c*) There is no object in playing 7 P to QR3, unless it be followed up by 8 P to QKt4.

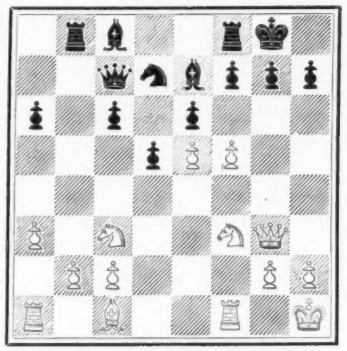
(*d*) Kt to Q2 seems better.

(*e*) P to QB4 should have been played here, and this might have been followed up by Kt to Kt3, guarding against P to B5 by White, and preparing for P to QB5 by Black.

(*f*) A very promising move in this position.

Position after White's Sixteenth Move.

Black.



White.

(*g*) To avert B to R6.

(*h*) White plays a spirited game. Black cannot play B × B, for after Kt × B the Black Knight cannot move to defend the KP.

(*i*) A most unfortunate position. There seems no possibility for Black to develop his QB. Now will be seen the importance of Black playing 7 P to QR4, enabling him to play B to R3 when necessary.

(*j*) White deserves great praise for the courageous conduct of the game.

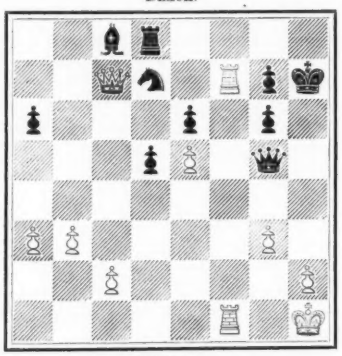
(*k*) White threatened Kt to Kt5.

(*l*) R × P at once, was perhaps his best chance.

(*m*) To take the two Rooks for the Queen would hardly pay in this position, though it was advisable to do so.

Position after White's Thirty-Second Move

Black.



White.

(*n*) Q × P was tempting but delusive; for instance; Q × P, 34 Q × R, B to Kt2 (ch); 35 K to R3, Kt to B3; 36 R × P (ch), K × R; 37 Q to K7 (ch), and wins. R to Ksq was feasible.

(*o*) White finishes up in good style.

Contents of No. 54.

	Page
House-flies and Bluebottles.—II. By E. A. Butler	103
Hindu Arithmetic. By Frederic Pincott, M.R.A.S.	105
Walks in the Sydney Botanic Gardens. By C. Parkinson, F.G.S.	107
Flying Dragons. By R. Lydekker, B.A.Cantab.	109
The Bamboo and its Kindred. By R. Camper Day, B.A.Oxon.	111
Notices of Books	113
Letters:—Asaph Hall, George Knott, Robt. W. D. Christie, J. Shaw, J. F. King, "γ Draconis"	117
The Face of the Sky for April. By Herbert Sadler, F.R.A.S.	119
Whist Column. By W. Montagu Gattie	120
Chess Column. By I. Gunsberg	12

TERMS OF SUBSCRIPTION.

"Knowledge" as a Monthly Magazine cannot be registered as a Newspaper for transmission abroad. The Terms of Subscription per annum are therefore altered as follows to the Countries named:

	s.	d.
To West Indies and South America	9	0
To the East Indies, China, &c.	10	6
To South Africa	12	0
To Australia, New Zealand, &c.	14	0

To any address in the United Kingdom, the Continent, Canada, United States, and Egypt, the Subscription is 7s. 6d., as heretofore.

Communications for the Editor and Books for Review should be addressed Editor of "Knowledge," care of J. Malaby, 67 Chancery Lane, W.C.